Twelfth International Symposium on

WATER MANAGEMENT AND HYDRAULIC ENGINEERING

BOOK OF ABSTRACTS

Editors:
Wojciech Artichowicz
Jerzy M. Sawicki

5-8 September 2011, Gdańsk, Poland

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WYDZIAŁ INŻYNIERII LĄDOWEJ I ŚRODOWISKA

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Twelfth International Symposium
on Water Management and Hydraulic Engineering

WMHE 2011

5-8 September 2011
Gdansk, Poland

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Gdansk University of Technology,
Faculty of Civil and Environmental Engineering, Gdansk, Poland

In collaboration with:

University of Zagreb,
Faculty of Civil Engineering, Zagreb, Croatia

Slovak University of Technology,
Faculty of Civil Engineering, Bratislava, Slovakia

BOKU University of Natural Resources and Applied Life Sciences,
Institute of Water Management, Hydrology and Hydraulic Engineering,
Vienna, Austria

University of Ss. Cyril and Methodius,
Faculty of Civil Engineering,
Department of Hydraulics, Hydrology and River Engineering,
Skopje, Macedonia

Under the auspices of:

IAHS - International Association of Hydrological Sciences

General information

WMHE 2011 is the Twelfth International Symposium in the field of Water Management and Hydraulic Engineering. The meetings provide a unique forum for presentation and discussion of recent work on different aspects of water and environmental management, including physical sciences and modeling.

The aim of the conference is to encourage and facilitate the interdisciplinary communication between scientists, engineers and professionals working in water management and hydraulic engineering. It considers both, surface and ground waters based on a basin wide approach. This conference contributes to these goals by inviting the experts from Central Europe that are the members of EU as well as the experts from the South-East-Europe countries, which are not yet member states. The main idea is to exchange experiences in the field of water management and hydraulic engineering including aspects of ecosystems and sustainable development.

This successful series started in 1984 as a bilateral activity between the Gdansk University of Technology (Poland) and the University of Zagreb (Croatia). Since 1998 participants from the University of Technology in Bratislava (Slovakia), University of Ss. Cyril and Methodius in Skopje (Macedonia), and the BOKU University of Natural Resources and Applied Life Sciences in Vienna (Austria), contribute regularly to this two-annual conference series.

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Symposium Topics

1. Hydraulic Engineering and Environmental Impacts
   - Problems of hydraulics
   - Hydro engineering
2. Sanitary Engineering and Sustainable Water Use
   - Water supply and sewerage
   - Water treatment and waste disposal
3. Water Resources and Environmental Management
   - Water management
   - Problems of hydrology

Symposium Secretariat

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THE UNIQUE WATER SUPPLY AND SEWERAGE SYSTEM IN GDAŃSK TODAY

I am pleased to present you the water supply and sewerage system in Gdańsk as seen by an engineer who for many years has been responsible for its operation. In many aspects, it is a unique and fascinating system, both in terms of the technical details as well as its management and effects. The operation and management of the system was entrusted to Saur Neptun Gdańsk. The company carries on the activities of Okręgowe Przedsiębiorstwo Wodociągów i Kanalizacji w Gdańsku (OPWiK), the former local water supply and sewerage company for Gdańsk, and is in charge of water supply and wastewater disposal in Gdańsk and Sopot. The wastewater treatment plant "Wschód" under management of the company is one of the largest treatment plants in Poland and also provides water services to the communes neighbouring on Gdańsk. The total water supply and sewerage network in Gdańsk and Sopot is more than 2.5 thousand km long and it is extremely diverse in terms of age, component materials and performance requirements.

The water supply and sewerage system in Gdańsk is one of the oldest in Europe. It dates back to the 14th century when water was supplied from the Radunia Channel and Siedlicki Stream via a system of oaken pipes (Fig. 1), hollowed out by burning the core and coupled with lead connectors.

Gdańsk was one of the first European cities to have constructed a complete water supply and sewerage system in response to the urgent need to improve the health and hygiene conditions of living in the city, to reduce epidemic outbreaks and to achieve a longer life expectancy for the city residents. The modern water supply and sewerage system, associated with the person of E. Wiebe[1)], dates from 1869 when a drainage water

[1)] Friedrich Eduard Salomon Wiebe (1804–1888), German engineer, author of the first modern solution for the sewerage system in Gdańsk dated back to 1863-1864, published in Berlin in 1865. He showed interest in railroad engineering to be taken up with developing city sewerage systems

intake was constructed in Pręgów and connected with the city via a cast-iron water main Ø418 in diameter.

Fig. 1. A unique water supply pipe made of wood, preserved to date and located in the courtyard of SNG SA headquarters in Wałowa Street

This water intake has been efficiently operated to date, and a recently constructed water treatment station in Pręgów was put into operation in 2010.

It was unique at that time to have a sewerage system and a wastewater treatment plant by way of percolation fields in Stogi constructed at the same time. However, these fields put out of operation in the 1970 s.

The parallel development of Gdańsk and its water supply and sewerage system in the wake of the evolution of engineering technologies caused that today it is extremely diverse and interesting.

The city of nearly half a million inhabitants is supplied with water from a dozen or so water intakes. Aside from the drainage water intake referred to above, the city is supplied with water from 17 operating deep water intakes where water is drawn from different water-bearing layers. Water is taken in by more than 100 wells to the depth of 40 m to

after his study tours to France and England. His name is associated with the sewerage systems in Frankfurt am Mein, Wrocław, Królewiec, Basel and Triest.

over 200 m. In 1986, the water intake “Straszyn” was released to service as a result of the water stress. It is a surface water intake where water is drawn from the Radunia River, and more specifically from the flow-through lake of water power plant. The Radunia River originates from the Raduńsko-Ostrzyckie Lakes in the Kaszuby Upland. Currently, 61% of water supplies come from deep water intakes, 29% from surface water intakes, and 10% from drainage water intakes.

Fig. 2. Brick intercepting sewer in Hallera Street in Gdańsk

For more than 2.5 thousand km, water runs through a system of water and sewerage pipes, with a few dozen of intermediate pumping stations, arrives at end users to be discharged to the wastewater treatment plant “Wschód”. It is worth noting that 100% of wastewater undergoes treatment. The material structure and age of the pipeline network has changed with time. The prevailing material is cast-iron (33.5%), stoneware clay (27.76%), PVC (13.06%), reinforced concrete, AC concrete (11.05%), PE, steel, brick, vipro, lead and other. It goes without saying that different materials require e.g. different repair methods. The age and technical condition of the pipes can also affect the quality of pumped water. 30% of the network is more than 50 years old, while only 40% is less than 20 years old. Interestingly, most of the repairs are carried out on the sections constructed in the 1970s, i.e. when substitute materials and low quality were quite common.

The treatment methods vary according to the type of piped water – be it drainage water, surface or underground water. As a rule, people from outside of this industry are not aware that water intakes or wastewater treatment plants are industrial facilities based on highly sophisticated technologies.

As regards the Straszyn water intake, it has served its purpose, i.e. made it possible to eliminate water deficit (at the moment, owing to the reduced water consumption per capita, it is no longer a problem), but it has also been widely criticised by the residents of the so-called “upper terrace of Gdańsk” supplied with water drawn from this intake. This criticism resulted from obligatory chlorination of surface water, which does not apply to deep groundwater, and lack of customary chlorination practices. Incidentally, e.g. in the USA, non-chlorinated water is considered “uncertain”, and in many restaurants tap water is served. We all remember heated discussions about the imputed carcinogenic properties of the water. Currently, thanks to the applied technologies, the residents are not able to differentiate between deep groundwater and surface water, and even declare they drink tap water.

Fig. 3. Technical systems at the surface water intake in Straszyn

For some years, the possible elimination of the Straszyn water intake has been considered, especially given the currently sufficient underground water resources. The decision would have specific financial effects as it would require the water supply network

in Gdańsk to be partially reconstructed and the water intake to by physically eliminated (surface water intake cannot be kept in reserve). From the engineering point of view, the Straszyn intake contributes to operational comfort because the city is supplied from two sources. The major deep water intakes up from the sea, the Straszyn intake down from the moraine hills. There have been cases of the entire city being on emergency supply from one of these sources. Obviously, river water is of lower quality as a raw material, however, in the event of water contamination, a flowing river will be naturally purified and the intake could be soon put back into operation. This is impossible in the case of deep water intakes. It was precisely due to the Straszyn intake that during the flood in 2001, Gdańsk would have been the only city in Poland affected by the flood where the Sanitary and Epidemiological Station placed no ban on drinking water from the city network.

As referred to above, the percolation fields served as the first wastewater treatment system. In 1932, the wastewater treatment plant "Zaspa" was built based on the design prepared by Karl Imhoff[2)]. At that time, it was a state-of-the-art treatment plant in Europe. Extended and modernised, it collects wastewater from Sopot and such city districts as Zaspa, Żabianka, Przymorze, Brzeźno, Nowy Port. The wastewater treatment plant "Zaspa" was put out of operation at the end of 2008, and all wastewater from Gdańsk and Sopot is discharged now to the wastewater treatment plant "Wschód". It was constructed in 1974 and from the start it operated as a regional treatment plant, i.e. serviced Gdańsk, Sopot, and the following communes: Żukowo, Kolbudy, Pruszcz Gdański. In the extended and modernised plant a 3-phase treatment procedure has been implemented. The wastewater outfall has been taken out into the sea at a distance of 2.5 km and it was the first such project to have been implemented in Poland.

The modern treatment plant is also used as a sewage sludge plant. The better the treatment of wastewater, the more sewage sludge by-products. It is a general problem in Poland, especially in large cities. Gdańsk generates 45 thousand m^3 of sewage sludge on an annual basis. Figuratively speaking, this volume equals to 10 large lorries a day. At this level, natural (agricultural) methods are out of the question. The added complication is the surrounding area of Gdańsk, i.e. the fertile alluvial delta area of Żuławy. In the years

[2)] Karl Imhoff, German engineer, author of numerous classical works on sanitary engineering, associated with the creation and putting into operation of the wastewater treatment plant "Zaspa" in the interwar period. Designed at the end of the 1920s as an experimental facility, it was to serve as a basis for a new sewerage system linking Sopot, Oliwa and Wrzeszcz.

2005–2010, we managed to put to use nearly 212 900 m^3 of sewage sludge on a phosphogypsum dump in Wiślinka where it was utilised as a fertiliser to prevent the dump from being overgrown with vegetation, which proved to be extremely helpful when the dump was put out of service by Gdańskie Zakłady Nawozów Fosforowych.

Therefore, a sewage sludge heat treatment station is the preferred target solution. It is planned to be put into operation at the end of 2011. The station will be constructed as part of the investment under implementation by the owning company, i.e. Gdańska Infrastruktura Wodociągowo-Kanalizacyjna (GIWK).

The topography of Gdańsk is also extraordinary as the difference in altitude between the seaside residential estates and the districts situated on the moraine hills is more than 180 m. In practice, this means that water has to be pumped up to end users on an iterative basis.

The water supply system in Gdańsk has 5 pressure zones. Interestingly, there are practically no elevated storage tanks which have grown to be a true decorative addition to the cityscape in some Polish cities. One of few such tanks is the tank concealed in the chimney of an old boiler room at the Gdańsk University of Technology. In the past, the tanks were located on natural elevations (Sobieski, Wysoki Dwór, Cyganka), and currently, designers of the Przymorze or Żabianka housing estates prefer modern technologies, e.g. water pumping stations. What a pity! It is possible that a new water tower will be constructed on the Sobieszewska Island in a few years. It will guarantee reliable water supply services for the entire island, after it is included in the central water main of Gdańsk.

It is also interesting to take a look at the exceptional organisational and legal solutions underlying the business of the current system operator, Saur Neptun Gdańsk. The company Saur Neptun Gdańsk has been set up by two partners – City of Gdańsk and Saur company, French baron on the global market of public services. At the time of its establishment, it was the first such enterprise in Central Europe referred to as a joint-venture company. The City of Gdańsk assumed 49% of the shares by way of an in-kind contribution in the form of a leasehold of the administrative and technical facilities of OPWiK in Wałowa Street as well as funds and working tools, and Saur assumed 51% of the shares and made a contribution in money which could have only been used to improve the quality and technical performance of the SNG. The new company has taken over all employees. The services provided for the residents of Gdańsk and Sopot are regulated based on the contracts concluded with these cities. A novel approach, which has found followers in some other cities as well, is based on a new model of relations, implemented

in 2005. The City of Gdańsk has set up its own owning company – Gdańska Infrastruktura Wodociągowo-Kanalizacyjna Sp. z o.o. (GIWK) – and now the cooperation is based on trilateral model as it is GIWK that owns the infrastructure.

Fig. 4. "Mamut" pump of 1908 located at the SNG SA headquarters in Gdańsk

Thanks to the contract with our company, Gdańsk has been granted a quality assurance guarantee for the provided services, including maintenance of stable parameters: pressure, water and wastewater quality, maximum response time in the case of failures. The effects of technical operation are more than spectacular. The quality of water has increased, water loss management has improved, and failures have also been considerably reduced. Today, hardly anybody remembers that the beaches in Gdańsk could be re-opened in 1994, after sixteen years of being prohibited to visitors, owing to the improved wastewater treatment technology.

The customer service policy has definitely changed for the better. We make continued efforts to enhance the quality of customer service and to reduce the number of complaints. As a result, the payment cycle was reduced by 80 days, and the debt collection index for 12 months in 2010 was as high as 98.72%. Our work is also recognised and well-thought-of among the residents. Every two years we carry out a survey of how our services and the company itself are perceived by our customers – the residents of Gdańsk and Sopot. The most recent survey of 2009 has clearly shown that the confidence in the quality of water in Gdańsk is consistently on the increase. As many as 31% of the

surveyed customers, i.e. nearly 150.000 people, admitted that they drink tap water and see no significant difference between the quality of deep groundwater and surface water. From numerous residents, the Straszyn Lake water has for many years been tantamount to unpalatable and unaccepted liquid. Today, thanks to the efforts of technologists, its quality is on a par with deep groundwater.

There are also some problems. In the 1990 s, installation of water meters in houses and flats had a snowball effect on the decrease in the water consumption level. Then, we faced a real challenge where to look for revenues, e.g. from the sale of services, and how to optimise the operating costs so that the tariff would be least affected.

Throughout its existence, i.e. for 19 years, the company has explicitly supported the benefits of such solution. From the start, Saur Neptun Gdańsk has been and still is perceived by international prestigious financial institutions (World Bank, EBRD) as a model example of public-private partnership in public services. In April 2011 our company, as one of seven water supply companies in the world, was awarded with a prestigious nomination to Global Water Awards for “Improved Performance”.

JACEK SKARBEK

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SPECIFICATION OF THE GDANSK WATERWORKS AND SEWERS SYSTEM MANAGEMENT MODEL

The speech presents key experiences and conclusions from the 5-year-period of functioning of the municipal company established for managing the maintenance and development of the Gdańsk waterworks and sewers system.

The Gdańska Infrastruktura Wodociągowo-Kanalizacyjna Sp. z o.o. (GIWK) [Gdańsk Waterworks and Sewers Infrastructure Ltd.] was established before the start-up of the investment project co-financed from European Union means allocated for the integration of the Member States. The aim of the project is to improve people's life quality. At present GIWK is performing a set of investment tasks connected with this aim, with the value over EUR 250 million.

Gdańsk – a city with about 450 thousand inhabitants – is located at the Gdańsk Bay, on the southern coast of the Baltic Sea. It borders two other big Polish cities, Sopot and Gdynia, as well as several other administrative units (communes) constituting parts of this urban area (Tri-City). Each city and each commune has got an independent waterworks system. As far as water sewage disposal is concerned, the Tri-City area is served by two systems connected with two big waste water treatments plants in Gdynia and Gdańsk. Local administration units that jointly use sewage disposal systems have to cooperate in system maintenance and development.

The Gdańsk waterworks and sewers system is exploited by Saur Neptun Gdańsk S.A. (SNG). It is a joint stock company of the Gdańsk Commune and the French SAUR corporation offering services in the municipal sector. To perform water supply and waste water collection services the SNG uses the waterworks and sewers infrastructure leased from GIWK. The funds obtained from the lease are redistributed by GIWK for investment purposes.

An intense economic growth in Poland after the political system transformations results, among others, in high activity of investors in the housing sector. The City of Gdańsk has got within its administrative limits many undeveloped so far investment areas without underground fittings. The fittings development requires the cooperation of GIWK and SNG with individual investors. This situation creates a lot of challenges connected with

reconciling sustainable minimization of obstacles to investment performance and long-term interests of the City and its inhabitants.

The above-mentioned technical conditions and organizational aspects of waterworks and sewers services provision in the Gdańsk area with regard to their support by EU aid means are the subject matter of this speech

SYMPOSIUM PROGRAMME

Monday: September 5, 2011

$8^{\underline{00}}$	–	$9^{\underline{30}}$	Registration and breakfast
$9^{\underline{30}}$	–	$11^{\underline{00}}$	**WMHE 2011 Opening Ceremony and Sponsors Presentations**
$11^{\underline{00}}$	–	$11^{\underline{30}}$	**Coffee break**
$11^{\underline{30}}$	–	$13^{\underline{00}}$	*Session:* **Hydroengineering** part I

Session chairperson:

Georg Schuster

Presentations:

Dana Barokova, Andrej Šoltész
DRAINAGE AND INFILTRATION RESISTANCE OF RIVERS –ELEMENT OF INTERACTION BETWEEN SURFACE WATER AND GROUND WATER

Emilia Bednárová, Danka Grambličková, Marian Minárik
SAFETY OF HYDRAULIC STRUCTURES AFFECTED BY NATURAL ENVIRONMENT

Gordon Gilja, Damir Bekić
IMPACT OF MORPHODYNAMICAL CHANGES ON THE BRIDGE STABILITY: CASE STUDY OF JAKUSEVAC BRIDGE IN ZAGREB

Boris Beraković, Eva Ocvirk
SHPP FAJER MILL ON THE GLINA RIVER IN CROATIA

Ivan Blinkov, Stanimir Kostadinov, Ivan Marinov
SPECIFIC EROSION CONTROL MEASURES IN SOME BALKAN COUNTRIES

Roman Cabadaj
NAVIGATION OBJECTS ON SMALL WATER STRUCTURES

Dalibor Carević, Eva Ocvirk, Marko Pršić
REDUCTION OF WAVE LOAD ON THE PERFORATED SEAWALL DEFENDED BY THE SUBMERGED BREAKWATER

Josip Galić, Tomislav Kišiček, Zorislav Sorić
REINFORCED CONCRETE STRUCTURES FOR RIVER TRANSPORTATION IN REPUBLIC OF CROATIA

$13^{\underline{00}}$	–	$14^{\underline{30}}$	**Lunch**

$14^{\underline{30}}$ – $16^{\underline{00}}$ *Session:* **Hydroengineering** part II

Session chairperson:

Andrej Šoltész

Presentations:

Teresa Jarzębińska, Wojciech Majewski
PROPOSAL OF THE SECOND HYDRAULIC PROJECT ON VISTULA RIVER DOWNSTREAM OF WŁOCŁAWEK PROJECT

Gints Jaudzems, Elena Govsha, Boriss Gjunsburgs
FLOOD DURATION IMPACT ON SCOUR NEAR HYDRAULIC STRUCTURES

Martin Orfánus, Radomil Květon, Peter Šulek
THE DIRECTIVE OF DAM BREAK MODELING FROM THE HYDRAULIC STRUCTURE AND TWO DIMENSIONAL NUMERICAL MODELS

Ján Rumann
MEASUREMENTS ON THE INTAKE STRUCTURE OF THE DOBROHOŠŤ SMALL HYDROPOWER PLANT

Ivona Škultétyová
MODELLING METHODS OF LANDFILL LEACHATE

Ivona Škultétyová
MINIMALIZATION OF SOLID WASTE LANDFILLING BASE ON WASTE ANALYSES

Peter Šulek
HEURISTIC OPTIMIZATION METHODS IN THE PROCESS OF WATER MANAGEMENT – ENERGETIC PLANS FOR REGULATING HYDROPOWER PLANTS

Dalibor Carević, Eva Ocvirk, Štefan Stanko
REVIEW OF WIND-WAVE GENERATION

$16^{\underline{00}}$ – $16^{\underline{30}}$ **Coffee break**

$16^{\underline{30}}$ – $18^{\underline{00}}$ *Session:* **Poster session**

Posters:

Zlatko Zafirovski, Darko Moslavac, Milorad Jovanovski, Marijana Lazarevska
ANALYSIS OF THE BEARING STRUCTURES OF DIVERSION TUNNEL

Aneta Łuczkiewicz, Wojciech Artichowicz
OCCURENCE OF ANTIMICROBIAL RESISTANT BACTERIA IN ENVIRONMENT AND THE STATISTICAL ANALYSIS OF THIS PHENOMENON

Petko Pelivanoski, Zivko Veljanovski, Goce Taseski
METHOD FOR DETERMINING THE OPTIMAL SOLUTION FOR DISPOSING OF WASTEWATER IN THE UPPER COURSE OF RIVER TRESKA

Todorka Samardzioska
NUMERICAL MODEL FOR TWO PHASE FLOW TROUGH POROUS MEDIA

Diana Šustić, Zdenko Tadić, Lidija Tadić
COMPARISON OF DIFFERENT METHODS FOR CALCULATION OF HIGH WATER HYDROGRAMS ON SMALL, INSUFFICIENTLY ANALYZED WATERSHEDS

Marko Pršić, Eva Ocvirk, Vladimir Vlasac
THE STATE OF THE RUBBLE MOUND BREAKWATERS' PRIMARY COVER LAYER IN ISTRIA

Goran Lončar, Marin Paladin, Vladimir Andročec
NUMERICAL MODELING OF RECTANGULAR SETTLING TANK EFFICIENCY

Josip Marišić, Davor Romić
SOME PROBLEMS IN RUNNING THE NATIONAL PROJECT OF IRRIGATION AND MANAGEMENT OF AGRICULTURAL SOILS AND WATER IN CROATIA

$19^{\underline{00}}$ **Garden party**

Tuesday: September 6, 2011

$8^{\underline{00}}$ – $9^{\underline{30}}$ **Breakfast**

$9^{\underline{30}}$ – $11^{\underline{00}}$ *Session:* **Problems of hydraulics**

Session chairperson:

Josip Petraš

Presentations:

Damir Bekic, Gordon Gilja
COMPARISION OF FLOW VELOCITY VECTORS COLLECTED BY USING RTK-GPS AND BOTTOM-TRACKING AS A REFERENCE ON A BOAT MOUNTED ADCP

Mateja Blažević, Marko Pršić, Dalibor Carević
FUNCTIONAL RELATION BETWEEN REPRESENTATIVE WAVE PERIODS BASED ON WAVE SPECTRAL AND AUTOCORRELATION FUNCTION

Barbara Bohne, Isidor Storchenegger, Peter Widmoser
AN EASY TO USE CALCULATION METHOD FOR WEIR OPERATIONS IN CONTROLLED DRAINAGE SYSTEMS

Katarina Cipovová
APPLICATION OF FLOOD MAPPING METHODS ON FAILURE WAVE MODELLING

Goran Gjetvaj, Marin Paladin
TWO DIMENSIONAL SIMULATION OF FLOODS CAUSED BY DAM FAILURES

Georg Schuster, Cedomil Josip Jugovic, Gerold Hepp. Thomas Pfaffenwimmer, Hans Peter Nachtnebel
NUMERICAL AND PHYSICAL SIMULATION OF A RIVER BEND FLOW

Michał Szydłowski, Piotr Zima
NUMERICAL RECONSTRUCTION OF RUNOFF FROM UPPER STRZYŻA DRAINAGE BASIN BEFORE NOWIEC II RESERVOIR FAILURE

Josip Marušić, Damir Bekić
BASIC INDICATORS OF UNIVERSITY STUDIES OF CIVIL ENGINEERING IN THE HYDRAULIC ENGINEERING DEPARTMENT AT THE FACULTY OF CIVIL ENGINEERING, UNIVERSITY OF ZAGREB

Marija Vukelić-Šutoska, Ivica Vukelić, Zvonimir Vukelić
PRESENTATION IN THE APPLIED HYDRAULICS

$11^{\underline{00}}$ – $11^{\underline{30}}$ **Coffee break**

$11^{\underline{30}}$ – $13^{\underline{00}}$ *Session:* **Water supply and sewerage** part I

Session chairperson:

Štefan Stanko

Presentations:

Monika Bronišová, Dušan Rusnák
SEWER NETWORKS IN SLOVAKIA

Stanisław Mikołajski, Roman Jurec
THE MEANING OF THE RADUNIA RIVER FOR THE WATER SUPPLY SYSTEM IN GDAŃSK

Vanda Dubová, Ján Ilavský, Danka Barloková
CORROSION TESTS ON THE WATER RESOURCE PERNEK

Marlena Gronowska, Jerzy Mirosław Sawicki
ANALYSIS OF METHODS OF ROTATIONAL SEPARATORS DESIGN

Apoloniusz Kodura
INFLUENCE OF CHARACTERISTIC OF BALL VALVE CLOSING ON WATER HAMMER RUN

Ivana Mahríková
SPECIFIC TASKS OF OPERATION IN SLUDGE TANKS ON COMMUNAL WWTP

Davor Malus, Dražen Vouk, Dejan Kovačević
FIRE FIGHTING STANDARDS IN RURAL AREAS IN CROATIA

Davor Malus, Dražen Vouk, Dejan Kovačević
THE ASSESSMENT AND FORECAST OF SEDIMENTATION AT THE NOVE MLYNY RESERVOIR

Mladen Petričec , Gorana Ćosić-Flajsig
SUSTAINABLE WATER PRICE HARMONIZED WITH EUROPEAN WATER POLICY

$13^{\underline{00}}$ – $14^{\underline{30}}$ **Lunch**

$14^{\underline{30}}$ – $16^{\underline{00}}$ *Session:* **Water supply and sewerage** part II

Session chairperson:

Goran Gjetvaj

Presentations:

Inom Normatov
APPEARANCE OF THE RISK CONTAMINATION OF DRINKING WATER SUPPLY SOURCES AT RAINFALL AND VEGETATION PERIODS

Dušan Rusnák
DESIGN AND CALCULATION OF TANKS ON THE SEWER IN SLOVAKIA

Štefan Stanko
THE ALTERNATIVE SEWER SYSTEM DESIGN IN FLAT AREAS CONSIDERING SEWER TYPE

Štefan Stanko
COMPUTATIONAL ADVANCES IN SEWER SYSTEM APPRAISAL

Dražen Vouk, Davor Malus, Vladimir Poljak
MATHEMATICAL MODELING OF COMBINED SEWER SYSTEMS

Živko Vuković, Joško Krolo, Ivan Halkijević
THEORETICAL AND EXPERIMENTAL ANALYSIS OF CORRUGATE GRAVITY PIPES

Živko Vuković, Ivan Halkijević
NPSH FOR CENTRIFUGAL PUMPS

Katarzyna Weinerowska-Bords
SELECTED ASPECTS OF SIMPLIFIED RUNOFF CALCULATIONS IN URBAN CATCHMENT

$16^{\underline{00}}$ – $16^{\underline{30}}$ **Coffee break**

$16^{\underline{30}}$ – $18^{\underline{00}}$ *Session:* **Water treatment and waste disposal**

Session chairperson:
Živko Vuković

Presentations:

Ján Ilavský, Danka Barloková, Karol Munka
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$20^{\underline{00}}$ **Gala dinner**

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RISKS OF DANUBE SOURCES EXPLOITATION IN CONTEXT OF RAPIDLY DEVELOPING CAPITAL CITY AND ITS ENVIRONMENT

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$16^{\underline{00}}$ – $16^{\underline{30}}$ **Coffee break at GUT**

$16^{\underline{30}}$ – $18^{\underline{00}}$ **Transfer and visit to Old Town of Gdańsk**

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Thursday: September 8, 2011

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$10^{\underline{00}}$ – $17^{\underline{30}}$ **Excursion to Malbork Castle**
(Return time is approximate)

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DANA BAROKOVÁ, ANDREJ ŠOLTÉSZ

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DRAINAGE AND INFILTRATION RESISTANCE OF RIVERS – ELEMENT OF INTERACTION BETWEEN SURFACE WATER AND GROUND WATER

Properly define interaction between surface water and ground water is a complicated process which requires the use of hydrodynamic and water-balance equations. Study of the interaction between surface water and groundwater is of great importance in theoretical as well as in applied investigation. Quantitative assessment of the interaction can be performed through Cauchy-type boundary conditions with different resistances for discharge or recharge. Cauchy boundary condition is needed for proper representation of surface waters alternatively losing water through the bottom (high resistance) or gaining water mostly near the water surface (low resistance). Groundwater simulation package TRIWACO is program, which is capable for representing a Cauchy-type boundary with different resistances for discharge or recharge conditions, what is presented in the paper.

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SAFETY OF HYDRAULIC STRUCTURES AFFECTED BY NATURAL ENVIRONMENT

From the set of engineering structures the structures most connected with natural environment are hydraulic structures (reservoirs, dams, flood dikes and polders). Reliability of their operation is dependent on safety of their construction, which is in considerable manner dependent on factors of natural environment as hydrology, hydrogeology, geology, geotechnics, climatology, etc. Because these factors create input data of hydraulic structures design, their reliability is extraordinary important. Moreover, during operation of hydraulic structures these factors can be more or less changed. For example hydrological data before construction of hydraulic structure and after its 50 years of operation can be significantly different. In geological environment in the subsoil of flood dikes can occur after long term operation changes in structure caused by hidden piping. Due to excessive settlement of dams can origin overtopping of their sealing elements. Such changes of natural environment and parameters of construction of hydraulic structures cannot be excluded. During lifetime (preparation stage, design stage, construction stage, and operation stage) it is necessary to consider these factors. In the design stage are important mainly geological and geotechnical records. Here plays significant role not only investigation, but also methods of results processing and their consideration in design. Variability in input data can be suita-

bly applied in numerical modelling of given task. By solving safety of hydraulic structures during operation have important position monitoring. Interesting results can be obtained applying in-situ measurements, numerical modelling, statistical data processing and geophysical measurements of filtration flow. In proposed paper are presented lessons learned from consideration variability of natural environment in design of hydraulic structures and also in reviewing of their safety during operation. Results are presented on concrete hydraulic structures in Slovakia.

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COMPARISON OF FLOW VELOCITY VECTORS COLLECTED BY USING RTK-GPS AND BOTTOM-TRACKING AS A REFERENCE ON A BOAT MOUNTED ADCP

Previous investigations showed that the application of boat-mounted acoustic Doppler current profilers (ADCP) is limited in rivers with substantial bed-load transport if boat velocities are calculated by the built-in bottom-tracking method. In order to overcome this limitation the speed and location of the boat is collected by an external RTK-GPS unit. Nevertheless, few previous studies showed that the navigation errors may arise during pairing of ADCP and GPS units. This in turn may contribute substantially to the flow velocity errors in ADCP surveys, since the boat speed is usually of the same order of magnitude as the flow velocity. This paper presents comparison of processed raw velocity data between two methods of ADCP surveys: the first by using RTK-GPS as a reference and the second by using the bottom-tracking as a reference. For measured discharges and flow velocities the tendency of bias is analysed in both survey methods.

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IMPACT OF MORPHODYNAMICAL CHANGES ON THE BRIDGE STABILITY: CASE STUDY OF JAKUSEVAC BRIDGE IN ZAGREB

Anthropogenic activities in the river channel and on the watershed can increase natural morphological processes. This can result in underestimation of long-term river bed changes. Bridge foundations in these rivers are particularly sensitive if the local scour is superimposed to the general scour process. Regular monitoring along the Sava River in Zagreb during the last 20 years showed that significant changes of the river bed have occurred. This paper gives results of the monitoring of the river bed changes around the Jakusevac Bridge piers. Description of morphological changes was based on the hydraulic and hydrographic surveys. Flow velocities and discharges were collected by using acoustic Doppler current profiler (ADCP), and bathymetry surveys by using multi-beam sonar. The importance of regular monitoring of the river channel degradation around bridges is stressed, especially were bridges instability may cause significant consequences.

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SHPP FAJER MILL ON THE GLINA RIVER IN CROATIA

In the paper is presented small hydro power plant (SHPP) Fajerov mlin (Fajer mill) on the Glina River in Croatia. This example illustrates opportunity to use mill's sites for a new way of water power and energy use. In past water power and energy are used for running mills, saw-mills, weave equipment etc. Today this energy is used dominantly for electric energy production. Renewable energy resources use is today in Europe and in Croatia encouraged, including hydro power plants especially small one. Of special interest for SHPP are sites where in the past water power and energy was used, particularly from standpoint of environment acceptability and regional and country planning (land use). In spite of hard efforts in preparing SHPP in Croatia, there are more than modest results. In conclusion it is recommended some ways how to improve the use of small hydro in Croatia.

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SPECIFIC EROSION CONTROL MEASURES IN SOME BALKAN COUNTRIES

While soils are as essential to human society as air and water, soil degradation has not received nearly as much attention as the threats to these other two elements. On the Map of water erosion of Europe, South Europe is red "colored". Erosion in the Balkan countries through it on-site and off-site effects is a mayor problem of soil and water degradation.

This paper shows comparative analyses of specific erosion control works implemented in some countries from Balkan region (Macedonia, Serbia and Bulgaria). As a base for comparative analyses were used country reports related to erosion by countries and various available papers. Quantitative method - text analyze method was used for these study.

All natural conditions in the Balkan countries contribute to appearance of various erosion forms and intensity of processes. During the history, people who settled this region unmerciful used natural resources to fulfill their needs (cutting woods, incorrect plugging, overgrazing,..), which contributed to increase of erosion processes.

The erosion control in Bulgaria, Serbia and Macedonia was defined as an important problem. At the end of eighteenth century the first anti-erosion afforestation

were performed in Bulgaria. There are very successfully performed complex activities applied in torrent watersheds, as well as unique decisions for stabilizing of torrent beds and landslides. Organized erosion control works on the Balkan started in the beginning of the XX century (1905 – Bulgaria, 1907 – Serbia). The highest intensity of erosion control works were carried out during the period of communism (1945-90's). Various erosion control works was launched.

Bulgaria characterizes with largest afforestation almost 1 million ha. Beside it ecological river restoration approach has been in use for almost 50 years.

Serbia characterized with specific barrages and significant erosion control works on hilly agricultural areas.

Specific screen barrages and afforestation on extremely dry areas are characteristic for Macedonia.

On the other hands in all 3 countries is a trend towards continued reduction of the extent of technical and biological erosion control works in the last 20 years. During the last years (after 2005), considerable activity of torrential floods, which have been harmless for decades, has been observed in the region. Erosion control should be more intensive especially caring out specific measures from all countries.

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FUNCTIONAL RELATION BETWEEN REPRESENTATIVE WAVE PERIODS BASED ON WAVE SPECTRAL AND AUTOCORRELATION FUNCTION

This paper presents the analysis of compatibility between representative wave periods determined: statistically, from one-dimensional frequency wave spectrum and from autocorrelation function. Spectral density function and autocorrelation function are used to describe random but frequent signals, such as wave records. Autocorrelation function is a measure of correlation between values of a random process at successive time instants. Spectral density function describes how the wave energy is distributed with frequencies of spectral decomposition of random signal. Analysing short wave records of Adriatic sea during some wave situation, frequency wave spectra and autocorrelation functions were obtained. Their corresponding representative periods were determined and compared to periods obtained by statistical analysis of wave records in order to define a functional relation between them.

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AN EASY TO USE CALCULATION METHOD FOR WEIR OPERATIONS IN CONTROLLED DRAINAGE SYSTEMS

Targeting to support local and regional authorities, agencies and engineers in charge with rural water management we developed a model to simulate unsteady discharge and recharge land drainage systems controlled by weirs. The model consists of algorithms and equations suitable to be solved on commonly used software as there are Programs for EXCEL, Mathlab and Octave and use storage equations, flow formulas for ditches, weir equations for free and submerged flow and simultaneous equations of instead drainage. Based on parameters of the drainage system and weir characteristics as well as to the flow conditions in the ditches varying due to different maintenance schedules the time needed to lower or raise the groundwater table at strived elevations are computed.

Local and regional appointees are enabled to operate weirs (preferably remote controlled) based on weather forecast in order to store precipitation to mitigate floods, to reduce erosion and to control nutrient leakage as well as to provide for optimal water supply for food and fibre production and for distinct habitat conditions.

In addition to support decision making in operating facilities and design or redesign devices as weirs, ditches and land drainage systems the program may serve to acquire data of the hydrological cycle. Remote controlled weirs require data transfer between weir and operator. Data of upstream and downstream water level permit the operator to control the gates in order to achieve levels and discharges according to agreed guidelines. If the operations and water levels are recorded the weir equations of the programs serve to compile/generate a quite accurate runoff record. Additionally in the catchment area recorded meteorological data may be used to balance the water cycle and to determine evapotranspiration the values of which are missed greatly.

We present 4 to 5 worked examples and demonstrate that weir controlled land drainage systems become an important feature in order to manage rural water resources which set up the major part of all large scale water management systems.

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SEWER NETWORKS IN SLOVAKIA

Beginning of construction of sewer systems in Slovakia goes back to the 19th century; the biggest development was the building after 1960. In cities and towns has been and is mainly operated a combined sewer system. Wastewater treatment plants (WWTPs) has been designed and implemented to eliminate only the organic pollution.

Recently, the construction of a public sewerage (PS) provides mainly divided sewerage system. A large part of the WWTP in recent years is currently intensified and reconstructed with the proposed technology degradation of biogenic elements.

At the end of 2008 was supplied with water from public water systems (PWS), 86,3% of Slovakia's population, the proportion of people living in houses connected to the PS was 59,06%, the total length of sewer (without attachments) reached 9 266 km and the number of WWTP was 577. Owners PWS and PS in Slovakia are municipalities, cities and water companies, operation PWS and PS provide especially water companies.

Serious problem of existing sewer and drainage facilities is their total decrepitude. Sewer network largely achieved and excess materials behind the zenith of life which are built (especially concrete and reinforced concrete). A frequent cause is a poor copy of the ditches and tight joints. These facts are generally the

cause of the reported high proportion of foreign water, which cause operational problems in sewers and WWTP.

Ensuring drainage and wastewater from agglomerations (AG) is governed by Law No. 184/2002 statute of water (the end of 2010 the AG over 10 000 population equivalent (PE), the end of 2015 the AG over 2000 PE). Establishment, development and operation PS regulated by Law No. 442/2002 statute complemented by other laws (230/2005, 394/2009) and regulations.

Is an important document "Plan of PWS and PS for SR“, which was under Directive 91/27/EEC and following the Law No. 184/2002 statute developed in 2006. That document shows plans for county development of PS. As sources of construction costs PWS and PS are the state budget, own funds, municipalities, EU funds and loans.

Law No. 394/2009 statute determines the duty of the owner of PS develop a recovery plan PS for at least 10 years. Details of the contents of the recovery plan states Decree Ministry of the Environment No. 262/2010 statute. The Decree provides content PS recovery plan and procedure for its development. There are currently plans for the recovery of PS in the AG in preparation.

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NAVIGATION OBJECTS ON SMALL WATER STRUCTURES

The absence of navigation objects, necessary to overcome the many water structures on Slovak rivers, makes the navigation of small pleasure boats very difficult and often causes situations that threaten the safety and lives of people who enjoy water tourism. This paper describes possibilities of navigation structures that solve these problems.

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ELABORATION OF CRRS MODEL ON THE EXAMPLE OF FLOOD WAVE AT THE BOTONEGA CATCHMENT

The conceptual parameter model with input – precipitation and output – runoff, the so called CRRS models (''Conceptual Rainfall – Runoff Models'') is being presented for the purposes of hydrological definition of runoff from saturated soil.

Elements that define input in CRRS modeling are: hydraulic runoff model and spatial model of terrain. The concept of hydrologic-hydraulic runoff model is based on the description of catchment surface flow of a very thin water layer appearing on the upper parts of the catchment slope before concentrating in the identifiable open bed of lower order. Spatial model is presented through discretization of catchment elements and provides information on terrain inclination, flow direction and flow path along the catchment surface. For runoff from saturated soil catchment the retention effect in CRRS model is *not taken into account*.

The model is presented for the catchment Botonega in Istria and is compared with conventional HEC-HMS model.

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REDUCTION OF WAVE LOAD ON THE PERFORATED SEAWALL DEFENDED BY THE SUBMERGED BREAKWATER

Perforated seawall could reduce significant wave heights in front of the seawall up to 20% in comparison with the classical solid seawall, but only for the specific relationship between wave parameters and seawall geometry. If the seawall is defended by the smooth submerged breakwater this reduction could be up to 50%, in joint action. Combination of the perforated seawall and submerged breakwater is a special type of the coastal defence structure which achieves great reduction of incoming wave energy. At the other hand, smooth submerged breakwater reduces loads on the perforated seawall what has favorable effects on the final costs. Reduction of wave load on perforated seawall when submerged smooth breakwater is placed in front of it is investigated in this work.

The interaction of the smooth submerged breakwater and perforated seawall was investigated in laboratory wave channel. Two experimental models were used, first includes loads on perforated seawall, and second loads on perforated seawall defended by submerged smooth breakwater. It is studied how the breakwater impacts on the wave load value of the perforated seawall. Pressures were measured at the front (perforated) and rear (solid) wall of the perforated chamber. Calculation of the horizontal forces from measured pressures was conducted, for each front and rear wall.

It was concluded that submerged breakwater decreases forces on front and rear wall of the perforated seawall in dependence of breakwater crown submersion. When breakwater crown is close to water surface the force reduction on the front wall achieves ~20%, and on the rear wall ~30%.

Also, mathematical model was formed for pressures calculation on the front and rear walls. Model was obtained assembling two mathematical models: empirical model for calculation of wave height transmission across submerged breakwater and semi-empirical model for wave load calculation on the perforated seawall.

Comparison of calculated and measured forces gives that calculated forces are in average 5% greater than measured for front wall, and 29% for rear wall. These results are conservative what was acceptable for engineering practice.

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APPLICATION OF FLOOD MAPPING METHODS ON FAILURE WAVE MODELLING

Following the Directive of The Ministry of Environment No.1/2007 – 1.5., the aim of this paper is to present the project of calculation the failure wave from Liptovská Mara water scheme and to emphasize the difference between 1D and 2D modeling of such a flood wave. This project also contains demolition effects evaluation.

In 2010 we participated in calculation of Liptovská Mara failure wave. A failure wave is a specific type of a flood wave caused by failure or crash of a water structure. Its characteristics are rapid increase of an extreme discharge and relatively short duration. The Directive of The Ministry of Environment from 30th April 2007 No. 1/2007 – 1.5 determinates the calculation methods of failure wave calculation.

Whole directive is predominantly 1D oriented. It allows application of 2D model in plane areas but for valleys with uniform flow direction it predetermines branch 1D model.

At a time when the Directive had been formed this approach was chosen because of limited application of 2D models. Because of high computing demandingness 2D modelling was applied only on relatively small areas.

Modern modelling tools and efficient computer-assisted techniques enable

exact 2D modelling of water flow on large areas and long river stretches.

This paper also contains recommendations for 2D model results interpretation and elaboration of results from MIKE 21 FM is described.

A very calculation was realized with MIKE 21 FM software with flexible computation mesh, which enables compressing the computation mesh at important objects, line structures or water-courses. Simulation of a failure wave is performed that far until its maximum discharge is lower than Q_{max100}. In case of plane areas simulation is performed till failure wave elevation falls to 0,5 m over existing ground. Correctly simulation should end not till the discharge falls under Q_a (average year discharge) or isolated water masses originate.

Submitted paper sufficiently demonstrates the necessity to modify the Directive for failure wave calculation so that modern computing systems could be used and more accurately results should be obtained.

This paper also contains application of Loss Curves for evaluation of damages caused by a flood wave.

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SUSTAINABLE WASTE WATER SLUDGE MANAGEMENT

Related to the necessity of the sustainable waste water sludge management and EU environmental policy requistes, Republic of Croatia had to improve the environmental legislation and planned the waste water treatment projects (included waste water and sludge lines).

In the paper will be presented the analyse of:

- the existing environmental legislation related to the waste water sludge in Croatia and their development reletated to the EU environmental policy the environmental policy;
- the existing sustainable waste water sludge management technologies in Croatia;
- the proposal of the environmental legislation and the proposal of the sustainable waste water sludge management technologies.

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SUSTAINABLE WATER PRICE HARMONIZED WITH EUROPEAN WATER POLICY

The harmonization of the Croatian water policy with European water policy means significant investments, especially in the field of the water supply, sewage and waste water treatment. Benefits of the improvement of the infrastructure and improvement of the people standard of living are immeasurable, but the water price growth is expectable fact.

In the same time, water price had to be sustainable, and the water service must be available and affordable for any house holding.

In the paper will be analyzed:

- existing state of the income availability and house holding water costs.;
- existing water price structure in Croatia and in the EU members;
- requirements of the European water policy and implementation water pricing policies that enhance the sustainability of water resources;
- achievement environmental objectives and promote integrated river basin management and achievement sustainable water price.

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UTILIZATION OF THE ENERGETIC POTENTIAL OF THE MANURE FROM A SWINE FARM IN MACEDONIA

This paper presents the main findings of the development and research project: Comparative analysis of possible solutions for preventing pollution of the River Temisnica with utilization of the energetic potential of the manure from the swine farm “Edinstvo”. It elaborates the problem of pollution of the water from the river and analyzes the manners for its protection through application of adequate technology for manure treatment from the same farm.

This development and research project gives recommendations for the manner of the treatment of the wastewater from the swine farm in accordance to the requirements of the European Directives for discharging treated wastewater into recipients, but also offers solutions that will valorize biogas that would bring benefits not only for the operators, but also for the environment, including water, soil and air. The proposed technology for treatment of the manure and the wastewater from the concerned farm that has actual capacity of 10.000 pigs, enables production of biogas during anaerobic digestion of the manure and its utilization for generating heat for heating of the digester and other structures of the farm, as well as generating electricity that will be used also at the farm. The comparison of the sum of the costs for construction of the required structures and installation of the facilities for manure treatment and utilization of the biogas under realistic

financing conditions (capital investments), costs for operation and maintenance and interest's costs to the financial benefit from the facility and generated energy pointed out to rather short return investment period of 7 years. This short period is possible due to already existing infrastructure and other installed mechanical equipment that is already in operation and which reduces significantly the investment costs. If entire infrastructure should be constructed, then the return period is much longer. For this type of specific operators, the real possibilities for so called "soft" financing shall be taken under consideration. That kind of financing enables positive results during elaboration of possible scenarios for profitability and return of the investment. This is confirmed by large number of farms in Europe and USA that successfully manage the manure treatment in sustainable manner from all aspects: technically, economically and regarding the environment protection.

Through the concrete solutions offered, the possibilities for replication in other swine farms in Macedonia have been open.

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CLIMATIC INFLUENCE ON SURFACE WATER RESOURCES IN THE REPUBLIC OF MACEDONIA

This study is twofold, the first part presents analyses of climatic data in the Republic of Macedonia, and the second part presents a case study in different river basins of surface water resources and their variability. The climatic analysis uses two main parameters including average air temperature and average precipitation from a total of 32 temperature and 160 precipitation stations recorded between 1961 and 1990. Modeled quantities of monthly precipitation and temperatures are derived by applying simple linear regressions and spatial interpolation Kriging methods.

The analysis of the water resources involves three major river basins including: Vardar,Crn Drim and Strumica basins. Variability of water resources is quantified through discharge data recorded annually from a total of 12 hydrological stations for the 1961 to 2003 period. The analysis of the minimal, maximal and average annual discharge suggests presence of reduction in annual amounts of discharge for all river basins in the country. The reduction of the average annual discharge is the most pronounced in the central and southeastern part of the country, i.e., in the region with moderate-continental-sub-

Mediterranean climate. The results indicate that river basins with lower precipitation amounts have experienced mostly higher reduction of the water resources.

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CORROSION TESTS ON THE WATER RESOURCE PERNEK

Internal corrosion has expressive effect on operating life of pipes, hydraulic condition in distribution system and quality of transported water. Each water is corrosive in some conditions, and level of this corrosion depends on physical and chemical properties of water and properties of pipe material. Galvanic treatment is innovation for protection against corrosion, this method is suitable for water stone removal too. Effect of this method consists in electrogalvanic principle, which is generated by flowing of water between zinc anode and cupro-alloy cover of column. At this article are presented experiments of corrosion tests on water resource Pernek, where is applied device working on this principle.

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REINFORCED CONCRETE STRUCTURES FOR RIVER TRANSPORTATION IN REPUBLIC OF CROATIA

In past 10 years, several reinforced concrete structures for river transportation in Croatia have been designed. Those structures were three quay structures and one slipway structure. So far, the first phase of quay structure on river Sava at Slavonski Brod and the slipway structure on river Sava at Sisak have been built. Second phase of quay structure on river Sava at Slavonski Brod has been designed and quay structure on river Drava in Osijek has been designed too. Beside that, in the frame of preliminary project for the multipurpose Danube-Sava canal, the preliminary design drawings and calculations have been made for two navigation locks with their avant-ports, five weirs, one siphon, two pumping-stations and a new port of Vukovar. In this paper some characteristic design parts of these structures will be shown.

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TWO DIMENSIONAL SIMULATION OF FLOODS CAUSED BY DAM FAILURES

The city of Zagreb is situated on the slopes of Medvednica mountain. Creeks that are formed on the southern slopes of Medvednica affect the city's sewage system. Torrential waters from Medvednica caused several floods in the city of Zagreb with significant damage and even human casualties. That was the reason for building flood protection system based on retention basins.

Since 1980 on the southern slopes of Medvednica 19 retention basins were constructed that fully protect central and western part of the city from torrential waters. All retention basins are formed with embankment dams. In the case of a sudden collapse of embankment dams, positive downstream wave (shock wave) will be formed. Areas downstream from the retention are densely populated, and in the flooded area there are some hospitals, schools, kindergartens, crafts and police facilities. Shock wave can cause loss of human life and serious material damage in the valley downstream of a dam. In order to analyze possible consequences of such a wave as well as their reduction, there is a need to analyze the hydraulic parameters of shock wave for engineering acceptable scenarios of dam failure. To define hydraulic parameters of such a wave a two dimensional model was developed. The model is based on MIKE 21 package. In this paper the developed model has been described and some results presented.

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ANALYSIS OF METHODS OF ROTATIONAL SEPARATORS DESIGN

Rotational separators constitute a special category of devices used for gravitational removal of suspensions from waste water. They are characterized by liquid flow that rotates around a vertical axis generating centrifugal force. The force retards suspended particles' motion relative to carrying liquid significantly elongating particles' residence time within the object, what has a positive influence on conditions of sedimentation or flotation processes.

Two methods of designing rotational separators can be found in literature regarding the topic:

1. The first method bears an assumption that the effective/characteristic particle (the smallest one from particles to be removed) stays motionless relative to separator walls (pressure force of liquid flowing towards chamber's axis is balanced by the centrifugal force F_o and force resulting from radial pressure drop F_r); bigger particles will move towards the outside wall, thus, will be removed; smaller particles will flow out with the carrier.
2. According to the second method radial velocity of the carrying liquid is neglected (as a result this method is more applicable to cyclones' design, devices used for dust removal, rather than rotational separators used for waste water treatment) and it is assumed that the forces F_o and F_r push particles towards

the outside wall with velocity *v*; time of particle's movement/displacement along the radial direction as calculated for velocity *v* should be equal to required settling time.

Both methods were applied to verify dimensions of exemplary series of types of rotational separators. The devices were preliminary designed by means of classical "volumetric" method (time of flow-through according to the plug-flow model is compared to required settling time) for diameter of characteristic particles equal 0.01 mm, treating the centrifugal force as an additional factor enhancing separators' operation.

On the basis of control calculations it was established that according to the first method devices will remove particles no smaller than circa 2.00 mm, while according to the second method – circa 6.00 mm. Were this results to be correct, series of separators should be disqualified.

In the light of such considerable divergence a detailed analysis of relations describing particular forces that were balanced in both methods was conducted. It was concluded that:

- liquid's velocity field in separator has been wrongly described, what, in turn, yielded incorrect value of the centrifugal force;
- radial pressure distribution has been also wrongly described resulting in an incorrect relation for corresponding transverse/lateral force;
- in the course of calculations radial component of motion both for liquid and suspended particle should be included;
- as liquid's motion in separator is turbulent, drag force should be described by Newton's formula instead of Stoke's formula.

Elimination of abovementioned deficiencies is a subject of further research.

Acknowledgement

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EVALUATION OF PRECIPITATION PARAMETER VALUES WITHIN THE RUSLE MODEL OF SEDIMENT PRODUCTION IN ISTRIA

The prediction of sediment production from a catchment area is frequently based on the application of a calculation procedure from some of the existing parameter methods for calculating soil erosion. Equations used for quantification of soil erosion are based on evaluation of each individual factor in the entire erosion process, such as precipitation, soil, relief, vegetation and human impact. The results of the long-term research of soil erosion at the research polygon "Abrami" facilitated the implementation of a reliable evaluation procedure for individual erosion parameters within the existing sediment production models. Based on the example of the precipitation parameter within the RUSLE model of sediment production, a description was given of the evaluation procedure and achieved results. The achieved results enable a more reliable determination of the precipitation parameter within the RUSLE model of sediment production in Istria, but also in other Croatian coastal and island areas in similar climate conditions.

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ADSORPTION AND REMOVAL OF ANTIMONY FROM DRINKING WATER BY OXIHYDROXIDE IRON

Heavy metals are one of the most hazardous contaminants of water resources. They can easily get into the groundwater resources.

There are several technological methods for removal of heavy metals in water treatment: precipitation (clarification), ion exchange, membrane technologies, adsorption, electrochemical processes and recently also biological methods.

Adsorption processes are based on the adsorption of contaminants on the surface of adsorption material. The molecules of contaminant pass from the water environment to solid adsorbent. For removal of heavy metals it is possible to use activated alumina, activated carbon or new adsorption materials such as granular hydroxide or ferric hydroxide (GEH, CFH12, CFH18, Bayoxide E33) etc.

At present, the adsorption by iron oxides and oxihydroxides represents efficient and cost-effective method for removal of heavy metals from water.

Removal of metals from water through sorption is influenced by water pH, water quality, concentration of metals, filtration conditions (filtration rate, contact time with the material, height of filter layer) etc.

Technological testing of groundwater from the spring in Dúbrava locality proved that new sorption materials (GEH, CFH12, CFH18, Bayoxide E33) can help reduce the content of antimony in water to the limits under the Regulation of the Government of the Slovak Republic No. 354/2007 on drinking water. For increase of efficiency of used sorption materials was applied permanent magnet. Results of these experiments will be presented in this article.

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GROUNDWATER VULNERABILITY MAPS IN THE REPUBLIC OF MACEDONIA

The fundamental concept of groundwater vulnerability is that some land areas are more vulnerable to groundwater contamination than others. This paper presents the methodology for vulnerability maps preparation in the Republic of Macedonia. Comparison is made for the existing methodology used in hydro-geological mapping for regional maps in the country, and new developing meth-odology. The new methodology is based on selection of number of parameters, and definition of rating system for each parameter. A multidimensional matrix is prepared for vulnerability evaluation of each parameter. The elements of this matrix describe vulnerability degree corresponding to combination of rating of the parameters assigned to the position of the element in the matrix.

The applied method can be described as an empirical rating system for the assessment of aquifer vulnerability. According to the preformed analyses, several typical examples of maps are presented using both methodologies. Finally, recommendations are given for future development in this area of hydrogeology.

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PROPOSAL OF THE SECOND HYDRAULIC PROJECT 0N VISTULA RIVER DOWNSTREAM OF WŁOCŁAWEK PROJECT

Vistula is the largest Polish River flowing from the south of Poland in the mountains to the Baltic Sea. Length of Vistula is 1047 km and its catchment amounts to 194 thousands of square kilometers. The catchment in Poland constitutes 169 thousands square kilometers thus occupying 54% of Polish territory. Lower Vistula section has 391 kilometers and creates important hydro-energy potential. After the Second World War the project of establishing Lower Vistula Cascade (LVC) was put forward. It consisted of 8 run-of-river hydraulic power plants of the total capacity 1300 MW and annual energy production 4200 GWh. The main aim of the LVC was energy production and inland navigation. In 1970 the first hydraulic project Włocławek was put into operation with power 160 MW and electric energy production in the average hydrological year 750 GWh. The project consisted of earth dam, hydraulic power plant, spillway section navigation lock and fish pass. This project resulted in impounding reservoir 55 km long. Next projects were planned upstream and downstream from Włocławek project. Unfortunately till today these projects were not developed, which caused a lot of negative consequences mainly erosion downstream of the project. During past 40 years of Włocławek project operation ecological problems and sustainable devel-

opment became very important. The paper presents information concerning the operation of Włocławek project together with all advantages and drawbacks as well as actions to mitigate negative consequences. One of the important problems of the operation of Włocławek project were ice phenomena and possibilities of ice jams. In 1982 a very important winter flood occurred on Włocławek reservoir. Now enterprise ENERGA wants to develop next hydraulic project downstream from Włocławek project. Hydrological analysis as well as possibilities of the location of the project are considered. New project should fulfill energy requirements, ecological restrictions as well as possibilities of inland navigation. The section of Vistula where new project is considered belongs to the NATURA Program, which imposes several important restrictions. Ice phenomena and sediment transport will be taken into consideration.

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FLOOD DURATION IMPACT ON SCOUR NEAR HYDRAULIC STRUCTURES

Transport system infrastructures – roads, bridges, dams as well as water intakes in rivers are under permanent impacts of multiple floods. To estimate its safety and stability because of scour, multidisciplinary approach is required with involving of principles of hydraulics, hydrology, morphology, geology and so on.

The affects of multiple floods probability, duration, sequence and frequency on safety and stability of engineering structures in river flow is studied. In the frame of this topic we studied impact of the flood duration and shape of hydrograph on scour process.

During past few decades equilibrium and temporal depth of scour has been studied by different authors. In those studies the flow parameters at the peak of the flood with unrestricted or restricted duration were used. However in nature the flow loads on engineering structures have form of hydrograph.

Method for estimation of scour development with time (Gjunsburgs et. al 2004) was used to make computer modelling and to find influence of flood duration and the shape of hydrograph on the scour process near engineering structures in river flow. The method is based on laboratory investigation and was confirmed by test results.

The duration of floods was changed and results described for floods with different discharge, shape of hydrograph and for different bed material grain sizes. The shape of hydrograph was changed with the time of recession part of the flood. The time of the rising part of the floods was constant, but the flood duration was different because of increased recession part of floods. Ratio between rising and recession time was changed, for example – 1:2, 1:3, 1:4, 1:6 and 1:8.

Scour development with time was similar in tests and computed by used in this study method – namely the rapid development at the start of the scour process and than gradual reduction with time. Scour process stops just after peak of the flood, and the time when the maximum depth is reached is usually less then duration of the flood.

It was accepted by computer modelling that flood duration increases scour depth. Influence of the shape of hydrograph on the depth of flow was found – the more recession time of the floods, the more is the depth of scour. With increase of the depth of scour at foundations, the safety and stability reduces and structure can be damaged. The results of this study are presented in tables and figures and confirm our conclusions.

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CHARACTERISTICS OF GROUNDWATER QUALITY IN GDANSK REGION

The area of the Gdańsk hydrogeological system covers about 2800 km^2. The recharge zone is situated on the glacial upland of the Kashubian Lake District. Its average elevation is 200 m a.s.l. The discharge zones, separated from the upland by a steep edge, include: Reda Ice Marginal Valley, marine terrace, western part of Vistula River Delta and the coastal areas of the Bay of Gdańsk, where under–sea discharge occurs, a very distinctive feature of the system. The Gdańsk hydrogeological system consists of three aquifers: Cretaceous, Tertiary and Quaternary.

The main usable water bearing bed in the Cretaceous aquifer is built of upper Cretaceous glauconitic sands. The roof of the horizon lies about 150 m b.s.l, its thickness in Gdańsk and Sopot surroundings (area of the most intensive usage), reaches 100 m and an average transmissivity is 25 m^2/h. The potentiometric surface in the discharge zone exceeds the ground level. Potential yield of a drilled well in the conditions of artesian flow surpasses the value of 100 m^3/h. In the 80–ties, which was the period of the most intensive usage (70 000 m^3/d), the potentiometric surface was lowered on a regional scale. Decreased output has resulted in a rise of potentiometric pressure. The process is still being observed. Above the

aquifer which is built of glauconitic sands a limestone and marl aquifer belonging also to upper Cretaceous occurs. It is of main importance for water supply in the eastern part of the region, situated in the Vistula River Delta. The Tertiary aquifer is built of sandy deposits belonging to Oligocene and Miocene. It is being exploited mainly in the discharge zone. The Quaternary aquifer in the Pleistocene upland consists of several water bearing beds. The deeper ones are the basis for water supply for numerous towns and villages. The water bearing bed in the Reda Ice Marginal Valley, marine terrace and in the western part of Vistula River Delta can be characterized by high transmissivity: 120–180 m^2/h, potential yield reaching 200 m^3/h and the thickness exceeding 40 m in some places. The Quaternary aquifer is one of the richest in groundwater in Poland and constitutes the basis for water supply in the agglomeration of Gdańsk–Gdynia.

The chemical composition of groundwater varies between aquifers. Nevertheless great similarities are visible between groundwater from Quaternary deposits in the Kashubian Lake District, where natural chemical composition is preserved and groundwater from Tertiary aquifer. The water is of HCO_3-Ca type with mineralization about 300–500 mg/dm^3. In the discharge zone (Reda Ice Marginal Valley, Vistula River Delta, marine terrace) the groundwater composition is often changed and the type HCO_3-SO_4-Ca and HCO_3-SO_4-Cl-Ca appears there. The main reason for the changes is connected with the processes invoked by uneven and intensive exploitation, which takes place in vadose zone and also with salt water intrusion. In some places contamination from the surface appears. As a result an increased amount of sulphates, chlorides, ammonia nitrogen and sometimes nitrate nitrogen is observed. Occasionally organic micro–compounds and other trace contaminants appear in groundwater. Generally the water is of good quality and meets the standards for drinking water. Only iron and manganese concentrations and in the Vistula River Delta – ammonia nitrogen exceed the limits.

Groundwater from Cretaceous deposits is of two different types: HCO_3-Ca and HCO_3-Na. An increased amount of chlorine ion causes change of type into Cl-HCO_3-Na or Cl-Na in some places. A specific component occurring in water from Cretaceous aquifer is fluoride ion. Its concentration in western part of Vistula River Delta reaches the value 4–5 mg/dm^3. In some areas an increased amount of ammonia nitrogen and hydrogen sulphide is also observed.

The current output in the Gdańsk hydrogeological system amounts to approximately 160000 m^3/d and the usage is concentrated in the Gdańsk – Gdynia

agglomeration. The amount constitutes about 30% of the disposable resources, which were estimated together with perspective resources at approximately 540000 m^3/d. In the 70-ties and the 80-ties of the previous century the total output was much higher and in the Gdańsk – Gdynia agglomeration amounted to 400000 m^3/d. The overexploitation has led to degradation of resources in the Gdańsk region in respect to quantity and the quality of the groundwater. Currently the resources in all the aquifers have been renewed.

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INFLUENCE OF CHARACTERISTIC OF BALL VALVE CLOSING ON WATER HAMMER RUN

Water hammer is one of example of transient flow in pressure pipelines. This phenomenon, due to its energy, can lead to significant problems in management and time of using of pressure networks. There are many components which have influence on water hammer run. Characteristic of valve closing is one of them. However that element is quite rarely investigated by using physical modeling. In this paper results of physical experiments of water hammer run in steel and PE pipelines are described and analyzed. For each water hammer run, characteristic of pressure and gate closing were stored. Results were compared with calculations by using common used methods by engineers – Michaud's and Wood and Jones.

As result very significant influence of characteristic of ball valve closing was observed. This observed influence can be quite important factor of water phenomenon run which should be taken under consideration. Comparison with theoretical method of calculations leads to improve limitations in using these methods.

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COMPARISON OF POOLING SCHEMES FOR SUMMER LOW FLOW IN SLOVAKIA

This study deals with the low flows seasonality analysis and its following regional distribution in Slovakia. Seasonality of low flows was analyzed using the data from 211 small and mid sized basins with an area ranging from 4 to 500 km2 and with the period of observations longer than 20 years during the summer season (May – November). The pooling procedure was based on grouping the relative frequencies of occurrence of summer minimum discharges lower then Q95 estimated in all observation stations. The pooling groups were constructed by the objective methods, using non-hierarchic K-means clustering, the correct number of cluster was determined form statistical method Silhouette and hierarchic clustering Average, Centroid and Ward clustering methods. The best classification was reached using the hierarchical Ward clustering method. This method divided the analyzed catchments into 3 groups. The first one represent Javorníky, Malá and Veľká Fatra, Biele Karpaty, Slovenské rudohorie, Malé Karpaty and Strážovské Mountains. Second group is typical for High and Low Tatras, Levočské Mountains, Ondavská Mountains. Thirt one is typical for Bukovské Mountains, Ondavské Mountains, Slánske Mountains, Juhoslovenská basin, Malé Karpaty ans Strážovské Mountains. The derived pooling groups can be subsequently used for undirected estimation of design minimum discharges on ungauged catchments.

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THE ESTIMATION OF THE MONTHLY RAINFALL INTENSITIES DESIGN VALUES IN THE NORTH-WESTERN PART OF SLOVAKIA

The methodology of the simple scaling is used in hydrology for the estimation of design values, the flood protection, the hydrological planning. In this study the theory of the simple scaling was applied to the rainfall intensities for the selected raingauge stations and the selected months in Slovakia. The methodology of the simple scaling was verified on 8 raingauge stations, where was a historical dataset of short-term rainfall intensities of durations from 5 up to 180 minutes in Slovakia. The design values were estimated for one raingauge station and they were compared with the traditional techniques. Using the derived scaling exponents (scaling exponents of the moments of the rainfall intensities) the 1-day precipitation totals were downscaled at the test station, and the design values of rainfall for durations d = 5, 10, 15, 20, 30, 40, 50, 60, 90, 120 and 180 minutes were estimated for selected station. The estimated design values of the rainfall intensities used to decrease from the small periodicities and the shortest duration (5 min) to higher periodicities and longer durations. The downscaled values of the design rainfall were compared to the results of Šamaj and Valovič (1973).Using this method we can estimate the design values of rainfall of selected recurrence intervals and durations shorter than a day by using only the daily data.

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THE RELATIONSHIPS AND INTERACTIONS OF OVERBORDER WATERS

The main formation of countries is based on historical land division, which was base on language and this was formatted mainly with the territorial nature boundaries. The large rivers, such as Danube, Morava, Ipel, Bodrog and others played the important role in this process. The rivers influence, as a protection of specific nation, were important many thousand years till the new age, which has no problem with transportation. The young people don't feel this historical influence, which formed our nations.

The paper focuses on the importance of over border rivers, specially on Slovak trans-boundary rivers, which influenced not only one nation, but 2 or more. The important role is the river protection, which has the direct influence on groundwater aquifers. The present age creates many opportunities for the river pollution and indirectly the groundwater pollution. We must to know the potential risks and threats and preserve the good environmental river conditions.

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SLOVAKIA WATER LEGISLATION IMPLEMENTATION

Water is one of the most extended resources which is essential for human existence. The topic rule of every human being and of every state is the preservation of water resources from local and global point of view by existing possibilities of their contamination.

The Slovak republic solves the water management problems based on a complex approach in protection and exploitation of the water from quantitative and from qualitative point of view. Water policy in Slovak republic follows fulfillment of tasks which consequences from entering Slovak republic into European Union as well as from the implementation of water directives.

More tools as management and legislation of water management are using for achievement of determine targets contributing to the preservation of a water wealth. Government department for development and environmental protection in Slovak republic is the Ministry of Agriculture, Environment and Regional Development of the Slovak Republic.

By Ministry are founded three state organizations and two allowance organizations. Ministry assigns and coordinates performance of state administration by activity of special state administration, interest associations and organizations.

The article refers about establishment style of water management, organization structure of water management in Slovak republic, legislative and normali-

zation activity. In the article is described implementation situation of directive from field such as water and trends from development of selected indicators of water management.

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DEVELOPMENT OF TURBIDITY AND TOTAL SUSPENDED SOLIDS RELATIONSHIP BASED ON LABORATORY SUBSAMPLES

Many catchments are being rapidly modified as a result of the shift from agricultural to urban land-use. The River Sitnica Catchment is experiencing uncontrolled changes in the land-use, too. The agricultural land in this catchment is being progressively covered by new structures and roads, resulting in an increase of the imperviousness of that area and consequently the increased surface runoff. In addition, considerable industrial development and surface mining activities are taking place in this area, too. These changes are in associated with high population growth rates and migration from other less urbanized areas.

All these factors are imposing enormous stress on the catchment's rivers. In particular, urban river reaches experience increase of almost all constituents, mostly oxygen demand, conductivity, total suspended solids and phosphorus. Concentrations of nutrients are also higher in urban river reaches, too.

Knowing that sediments are actually the most widespread cause of surface water impairment then the Total Suspended Solids (TSS) is an important water quality monitoring parameter. The increase of urban, industrial and agricultural discharges into surface waters in this catchment is expected to cause an increase of this constituent, too.

The Total Suspended Solids analysis provides an initial and very basic measure for characterization and study of surface water quality. Measuring the TSS in streams is nec-

essary both for monitoring stream quality and for planning management actions for protection. But, since the TSS measurement is relatively expensive and time consuming procedure this work represents a possibility to measure TSS through turbidity, as an easy to measure parameter.

In order to know the relationship between turbidity and TSS, the frequent sampling and their laboratory analyses are required. To avoid this, due to time, financial and personnel limitations the new approach is used in this work. The laboratory prepared subsamples will provide the necessary data for the development of a turbidity to TSS relationship.

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HYDROPOWER AS A RESTORATION OPPORTUNITY FOR OBSTRUCTED RIVER REACHES?

The demand for hydropower has shifted from the basic aim to meet increasing demands for electricity, to delivering renewable energy solutions that are sustainable, productive and effective for both society and the environment.

As hydropower causes hydromorphological alterations per se, the aim was to identify new potential sites having the least additional environmental impact. The Hypo-last project (Hydroelectrical Potential on Existing Lateral Structures in Austria) is an exploratory study of both the hydroelectric and ecological potential of existing lateral structures currently obstructing the river network throughout Austria. For example abandoned weirs, structures for riverbed stabilisation or flood protection. One of the scientific challenges of the project was the combined use of hydrological and ecological data based on different river network structures.

Using a database of 55,000 lateral structures, two categories of possible hydropower sites were defined (single obstacles/cascades) and transferred into the hydrological river network of the Hydrological Atlas of Austria. Mean monthly runoff data based on the 5,300 catchment areas of the atlas was calibrated with the daily means from 500 water

gauges and then used to calculate the mean annual discharge for 11,000 sites. After applying a selection set based on minimum economic criteria, 700 sites remained for further field investigation. On site surveys yielded data on the type of structure, accessibility, infrastructure, riparian morphology, hydraulic head, etc. to be used in a database that contributes additional decision support for both river basin management planning (WFD) and sustainable hydropower planning (RES). By matching hydropower potential with either restoration or mitigation potential for each site, a number of benefits accrue for decision-making.

The Hypo-last project identified 250 sites that can be considered as possible project sites to fund restoration or mitigation measures as required by the WFD and implemented in the Austrian Water Act.

For the praxis of river engineering within the European Union, it is necessary to understand the complementarity of the Renewable Energy Directive and the Water Framework Directive. By complementary is meant the balance between sustainable energy generation while sustaining the life-supporting qualities of the river ecosystem.

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NUMERICAL MODELING OF RECTANGULAR SETTLING TANK EFFICIENCY

The paper presents the results of numerical modeling of suspended sediment transport through a rectangular sedimentation tanks and comparison of model results with the measurements on physical models and measurements in nature. 2D numerical model is based on finite difference method with which the system of shallow-water and convective-dispersive equations are resolved. The measurement results are taken from literature references. Comparison of results of measurements and modeling indicate a satisfactory degree of correlation and thus verified the settings used in the implementation of numerical modeling.

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OCCURRENCE OF ANTIMICROBIAL RESISTANT BACTERIA IN ENVIRONMENT AND THE STATISTICAL ANALYSIS OF THIS PHENOMENON

In this study the occurrence of antimicrobial resistance patterns among fecal indicators (*Escherichia coli* and *Enterococcus* spp.) was analyzed in water and wastewater samples. The trends in antimicrobial resistance were analysed using basic statistical methods.

The samples were obtained from two local watercourses (the Oliwski Stream and from the Reda River) as well as from the wastewater treatment plant (WWTP) Gdansk – Wschod. The bacterial strains were isolated using the selective media and then the susceptibility analyses were carried out against the antimicrobial agents, important in treating human *E. coli* and enterococcal infection. To find the trends in antimicrobial resistance the results were analysed using basic statistical methods: the Kolmogorov-Smirnov Test (KST), Chi square independence test (the χ^2) and linear regression.

According to the obtained data at the Oliwski Stream the ratio of E. coli with resistance patterns to all tested E. coli isolates suggested the positive correlation downstream. At the Reda River such association was not observed. In case of enterococci the explicit correlation between the antimicrobial resistance rate against sampling points was also not confirmed. In case of wastewater samples the posi-

tive selection of resistant isolates was observed during the treatment processes. The obtained results may suggest that bacteria carrying antimicrobial-resistance genes have the survival advantages over the sensitive ones.

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SPECIFIC TASKS OF OPERATION IN SLUDGE TANKS ON COMMUNAL WWTP

Sludge treatment on the small and middle WWTP create separate unit by waste water treatment. In the past years was given enough care to it. The reason was missing legislation. After entrance of Slovakia to EU our republic follows to requests of EU, which are implemented in Slovak legislation. From 1^{rst} of January 2004 is valid Act. No 188/2003 Z.z. about application of treatment sludge and drain sediments into the soil. It established requirements on thick and dewatered sludge before its utilization in agriculture.

The improving of the building of new small and middle WWTP to the year 2015 will improve also the production of the treatment sludge. Therefore is the sludge problematic solution high actual. We expect growing number of WWTP with sludge treatment in open sludge tank.

In this paper you can find description of processes which overshoot in sludge tank. Operation monitoring of the processes in open sludge tanks on several WWTP, which were observed directly in the sludge objects and then on the model device, where was simulate several treatment conditions. The goal of our research was to create requested treatment condition in sludge tank, so that the process of sludge thickening and stabilization has sufficient efficiency and the treated sludge can be used according valid Slovak legislation in other processes.

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FIRE FIGHTING STANDARDS IN RURAL AREAS IN CROATIA

Rulebook on the hydrant network for firefighting (NN 8/2006) prescribes that each public water supply system in Croatia for the purpose of fire extinguishing should provide the flow of at least 10 l/s in the network, the minimum pressure of 2.5 bar, and 72m^3 of storage in the water reservoir. This requirement means that in practice the smallest pipe profile is DN110mm, which is considerably larger than needed for water supply in small rural settlements. In addition, hydrants should be installed on maximum distance of 300m, and sometimes booster stations to raise the pressure. Because of oversized pipes, water age is too high, which lowers water quality and endangers the consumers' health, accelerates deposition and increases the need for regular flushing. Of the total cost of construction, fire protection in rural areas ranges from 30–50%. Operation and maintenance costs are also increased due to increased pressure in water mains and a large number of appurtenances.

There are many rural settlements in Croatia populated with the residents of very limited economic resources. Respecting the principle of covering the costs of water supply from end users, the price of water is very important. Whether it is a

direct investment of local community, government investment, EU funds, or various combinations of sources of investment, available money should be channeled into projects that will include a large number of users.

By analyzing the frequency of fires in rural areas, their causes and consequences on people's lives and their property it was found that on average, small number of fires appear and therefore the number of victims and amount of damage which could be efficiently reduced by the construction of conventional hydrant network. Effectiveness depends primarily on equipment and training of professional and voluntary fire brigades. The authors propose that mentioned rulebook on hydrant network should be modified – supplemented by the articles that would allow fire fighting in rural areas without commercial and industrial buildings handled separately, giving priority to public water supply. Additional research is proposed and different technical solutions that can be applied to fire fighting besides the public water supply system.

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DEVELOPMENT OF MODELS FOR NITROGEN-REMOVAL PROCESSES IN SUBSURFACE FLOW CONSTRUCTED WETLANDS

The first approach to mathematical modelling for design and operation of wastewater treatment plants (e.g. activated sludge processes) was done in late 1960's. Since than, most commonly used models are based on the IWA Activated Sludge Models with Monod-type expressions used to describe process rates. While constructed wetlands (CW) are becoming increasingly popular for treatment of wastewater or surface runoff, models describing the biochemical and transformation processes of nutrients and organic matter in subsurface flow constructed wetlands were developed. CWs are complex systems designed and build to create best treatment conditions found in natural environment. The physical, chemical and biological processes are dynamically taking place next to each other, therefore influencing the main process of wastewater treatment. The most important task of the modelling is to closely understand the dynamics and process functioning of CWs systems, using simple mechanistic or process based models that can describe transformation and degradation processes in detail. This paper presents an up to date developments on modelling of subsurface flow CWs based on the available literature. Several kinds of models have been discussed: simple transport and first-order decay model, hydraulic or process based models, and a simplified model that has been developed for design of constructed wetlands.

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IMPORTANCE OF RESERVOIR TURČEK IN THE FLOOD PROTECTION

In the year 2010 in eastern and central part of Slovakia occurred several storm rainfalls which caused floods mainly on upper part of basins. These floods were accompanied by high material losses. From the flood protection measures one of the most efficient are reservoirs. In august 2010 village Turček situated on river Turiec was also stricken by flood. Above this village is situated fresh water supply reservoir Turček. Besides its main function his supplement purpose is flood protection. During flood the flood discharges were accumulated in this reservoir. Unfortunately only part of the basin above village Turček is protected by reservoir; tributaries of the river Turiec are not regulated. Flood discharges from these tributaries caused damage of several houses. If the reservoir Turček would not be constructed consequences of flood could be significantly higher. In our paper we are analysing contribution of reservoir Tuček to the flood protection of the land under this reservoir.

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SOME PROBLEMS IN RUNNING THE NATIONAL PROJECT OF IRRIGATION AND MANAGEMENT OF AGRICULTURAL SOILS AND WATER IN CROATIA

45 professionals and researchers from the Faculty of Agriculture and Faculty of Civil Engineering University of Zagreb, and eight related institutions from Croatia, along with 2 consultants from Italy (Naples) took place in creating the "National Project on Irrigation and Management of Agricultural Soil and Water in the Republic of Croatia" (NAPNAV) – from June of 2004 to July of 2005. The government of the Republic of Croatia issued on *17th of November 2005 the DECISION on accepting the Project NAPNAV, which features the irrigation system on the area of 65.000 ha of agricultural soil from 2006 to 2020.*

Irrigation plans for 19 out of 21 counties have been developed until 2010. In *2006, 2007 and 2008 preliminary and main designs for irrigation according to dynamic schedule of NAPNAV implementation were created*. However, in 2009 and 2010 some activities were not completed according to accepted NAPNAV programme. Professionals from Croatian *Waters Company*, *Ministry of Regional Development, Forestry and Water Management are participating in preparation of designs and other documentation for irrigation project.* In addition to the problems due to reduced finances there are the issues regarding organisation, institu-

tion and technical problems. The paper addresses basic indicators on executed works and issues due to which some activities were not carried out regarding both the development of project *documentation and irrigation system construction according the programmes from 2006 to 2010.*

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BASIC INDICATORS OF UNIVERSITY STUDIES OF CIVIL ENGINEERING IN THE HYDRAULIC ENGINEERING DEPARTMENT AT THE FACULTY OF CIVIL ENGINEERING, UNIVERSITY OF ZAGREB

Since the academic year 2005/06, the Faculty of Civil Engineering, University of Zagreb has conducted the program of *Undergraduate* and *Graduate University Course,* in agreement with the objectives of the *Bologna Declaration.* Basic indicators are given regarding hydrotechnical subjects evaluated by corresponding ECTS points. In addition to the students' program of 30 weeks, indicators are also given for other activities in the course of the studies of 14 weeks per annum. In the *Undergraduate course the student must achieve 180 ECTS points, and in the Graduate course120 ECTS points.* Eight mandatory and five optional (out of 12) hydrotechnical subjects in the Graduate Course of civil engineering are evaluated with 84 ECTS points, i.e. 70 percent of the required 120. The graduation thesis is valued 18 points, and the remaining 4 subjects also 18 ECTS points. Description is given of conditions for preparing of the final thesis of the *Undergraduate and Graduate Course of Civil Engineering.* Also, descriptive and numeric indicators for *hydrotechnical subjects* in the Post-Graduate Course are given, *separately for Doctoral and Specialist studies of civil engineering,* with conditions for preparing of the doctoral dissertation and specialist thesis on hydrotechnical subjects.

STANISŁAW MIKOŁAJSKI, ROMAN JUREC

SAUR NEPTUN GDAŃSK

THE MEANING OF THE RADUNIA RIVER FOR THE WATER SUPPLY SYSTEM IN GDAŃSK

The Radunia river, coming from post-glacial lakes of the Kaszuby Upland, is the best maintained river in Poland. There are 4 weirs, 9 water powerplants and 17 lakes and artificial reservoirs.

The Radunia river has been used for water supply of Gdańsk since 14th century, mainly through the canal constructed by the Teutonic Knights. The water supply system created at that time had functioned till 19th century. Since that time the basic source for water supply have been ground waters. In the eighties of 20th century the ground waters became insufficient since some of them were almost exhausted due to intensive consumption.

This problem was solved through the construction of water intake on the Radunia river reservoir. Using Radunia river water resources through Straszyn water intake proved to be the best source of water supply for Gdańsk from quantity and quality point of view.

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APPEAREANCE OF THE RISK CONTAMINATION OF DRINKING WATER SUPPLY SOURCES AT RAINFALL AND VEGETATION PERIODS

Tajikistan is a mountainous country located at altitudes from 300 up to 7000 m above the sea level. Cities, settlements and kishlak (villages) are located in valleys of the rivers, where the anthropogenic loading of contaminants in surface waters reaches a maximum. According to the results of water control analyses during storm rainfall, the bacterial pollution of the rivers measured by a contamination index can reach numerous amounts of intestine sticks in 1 liter of water (Varzob River – 3800 intestine sticks in 1 liter of water). The basic importance of infection transfer by waterways is especially evident in the dynamics of typhoid spreading, which is always characterized as very high. Thus between maximum (1984 - 69.0 on 100 thousand population) and minimum (1992 - 16.9 on 100 thousand population) number of cases, there is large variability (4 and more times), which is reflective of the fluctuations of epidemic activity due to waterway transfer through different territories. Groundwater plays an important role in the potable water supply of the population of Tajikistan. Water as a dynamical component of the ecosystem, possesses the ability to promptly transfer various pollution and infectious diseases to greater areas. Although this concern mostly surface

waters, groundwaters are not an exception. First of all the reason is that surface and groundwaters are constantly in dynamic interaction, and thus a penetration and diffusion of pollution into the groundwater aquifers takes place. Previous studies have shown a significant seasonal difference in the concentration of nitrates in groundwater: during the drought periods the concentration of nitrates was low, while during rains it reached 18 mg/dm^3. Tajikistan is an agrarian country, with cotton as the basic agricultural product. Water is one of the dynamic components of an ecosystem and is able to transfer pollution and infectious diseases in the big catchments studied. This is mainly of concern for surface water, but can also be of importance for groundwater. Since surface waters and groundwater are in a dynamic interaction, surface waters can also contaminate groundwaters and vice versa. The groundwater resources supply an appreciable part of the population of Tajikistan with potable water. Earlier, a considerable seasonal change in groundwater nitrate concentration was detected: during drought periods, the concentration of nitrates did not exceed standards, while in rainy periods it reached 18 mg/dm^3. The Republic of Tajikistan is an agrarian country, and cotton is the basic agricultural production. For good harvest reception, many farmers apply considerable quantities of mineral fertilizers and pesticides, thereby exceeding the established standards. Most wells of the rural population are near irrigated lands. The pollution of groundwater at storm rains and during the irrigation of lands is an unexpected experience.

In most cases the problem of water quality of the Zeravshan River consider in organic communication with activity of the Anzob Mountain-concentrating Industrial Complex (AMCIC). AMCIC is the mining enterprise for extraction and enrichment of complex mercury-antimony ores of the Dzhizhikrut deposit. It is located in a right-bank part the rivers Dzhizhikrut which are the left inflow of the river Jagnob (the river Jagnob is the right inflow of the river Fondarja which in turn is the left inflow of the river Zeravshan). The main ore minerals are antimonite. Since 1966 to 1970 reconstruction of industrial complex was spent and for the purpose of prevention of hit of sewage of industrial complex in the river Dzhizhikrut in village of Ravot (8-10 km from industrial complex) on left to river bank Jagnob was are built wastewater dams (WWD). With 1970 on 1994 pipelines of sewage functioned normally and from 1994 years a result of heavy rains pipeline pieces has been destroyed. In 2009 the industrial complex has completely restored pipelines and now dams in the complete set and works in the established

mode. For definition influence of the AMCIC on qualities of waters of the river Zeravshan were made sampling of water from the river in two points - on Fondarya and Pete Rivers is located accordingly before and after wastewater dams of AMCIC.

Comparison of results chemical analyses have shown about absence of the factor of pollution of the river Zeravshan by wastewaters of industrial complex.

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THE NEWEST INVESTIGATIONS AND APPLICATIONS OF TREATMENT WETLANDS IN SEWAGE SLUDGE MANAGEMENT

In the paper the newest investigations and applications of treatment wetlands conducted by researchers of Civil and Environmental Faculty are presented. Within the research project "BiDiCoWet" PL 0085 "New Methods of Emission Reduction of Selected Pollutants and Application of By-products from Sewage Treatment Plants", financed by EEA Financial Mechanism and Ministry of Science and Higher Education in Poland was proved that this technology could be successfully implemented for highly polluted wastewater treatment. The research program includes design, build and investigation of pollutants efficiency removal in two multistage treatment wetlands, one for landfil leachated and the second for reject water o from digested sewage sludge dewatering on centrifuge, which were build in 2008 year.

Within the research project *Innovative Solutions for Wastewater Management in Rural Areas* (financed by Polish Ministry of Science and Higher Education

E033/P01/2008/02 and EOG Financial Mechanism and Norwegian Financial Mechanism PL0271) the conception of sewage treatment and sewage sludge utilization at the TWs for individual households in a rural area was created. Within the project, nine individual treatment wetland were build with three different configuration to estimate their efficiency removal in accordance with local conditions. Applied technology enables to close the local cycle of water and organic substances what is in consistence with the state of agenda 21.

Also investigation of organic matter transformation and accumulation were conducted. Among other the investigations of the quality and quantity of refractory (recalcitrant) substances (similar to humic acids) in sewage treated by conventional and natural technology, were performed.

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REVIEW OF WIND–WAVE GENERATION

This paper presents the problem of the growth of ocean waves by wind. The generation by wind is an extremely complex process. It is a difficult problem because it involves the modelling of a turbulent airflow over a surface that varies in space and time. The process consist of the highly nonlinear interaction of two fluids whose densities differ by orders of magnitude. This implies a multi-phenomenological behaviour at the interface. Also it is difficult to measure growth rates of waves by wind in a direct manner. This paper shows historical development and the state of the art of our knowledge on the growth of ocean waves by wind. The combination of observations from field and the theoretical work on the critical layer mechanism has resulted in parameterizations of the wind-input source function that provide good results in operational wave models. Using some simplifying assumptions and measurements now we are able to formulate some basic theory that applied to the models provides rather good results.

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THE DIRECTIVE OF DAM BREAK MODELING FROM THE HYDRAULIC STRUCTURE AND TWO DIMENSIONAL NUMERICAL MODELS

The methodology of dam break modeling from the hydraulic structure designates the Directive of Ministry of Environment from 30th of April 2007 n.1/2007–1.5. The directive is largely devoted on one dimensional numerical modeling from hydraulic structure as extreme fluctuation of discharge under the hydraulic structure. Directive is accepting the two dimensional modeling in plain territories but for narrow valleys with distinct direction of flow designates the one dimensional branching simulation. This consecution was developed at the time of limited two dimensional simulations especially for relatively small territories because of time-consuming computation. Up-to-date modeling tools and high effective computers are making the two dimensional modeling of water flow more accurate for large territories. The submission is defining the results interpretation of two dimensional modeling as well as dam break modeling. Also the adaption of results from flow model MIKE 21 FM with flexible computing mesh is described for territory of river Váh under the Trenčianske Biskupice weir.

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ASSESSMENT OF INTERNAL WATER DRAINAGE IN EASTERN SLOVAK LOWLAND. DRAINAGE SYSTEM ESL-3

Water management improvements have several centennial tradition on the Eastern Slovak Lowland (ESL). There was in this region within living memory the problem with periodic floods as well as disorder runoff conditions. It was solved gradually by building-up the pumping stations, dams and river regulation. The dams on the rivers worsened internal waters outflow. These induce waterlogging and flooding of agricultural land. Nowadays there are built large drainage systems (DS) on big surfaces on the Eastern Slovak Lowland by the rivers Ondava, Laborec, Uh, Latorica and Bodrog. There are drainage systems as ESL-1,2, ESL-3, ESL-4, ESL-5, DS Kamenná Moľva, DS Hraň. ESL-3 involved with the pumping plant (PP) Čičarovce, Ptrukša and Pavlovce over the Uh. The assessment consists in the evaluation of drainage system ESL-3 effectiveness and draft of measures.

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THE EIS METHOD AND Z-METER III DEVICE

Electrical impedance spectrometry (EIS) enables the detection of the distribution of impedance or other electrical variables arising from it (resistivity, conductivity, etc.) [1, 2], inside a monitored (homogeneous and heterogeneous) object, and thus the observation of its inner structure and its changes. Due to the electrodes used and the way of their location in a monitored object, it is possible to use the method as non-destructive invasive or non-invasive. The method ranks among indirect electrical methods [3] and is used in measuring the properties of organic and inorganic substances. It constitutes a very sensitive tool for monitoring phenomena that take place in objects (e.g. changes occurring in earth-fill dams when loaded by water, in wet masonry when being dried, in sewerage systems during the transport of water with sediments), electrokinetic phenomena at boundaries (e.g. electrode/soil grain, between soil grains) or for describing basic ideas about the structure of an inter-phase boundary (e.g. electrode/water).

The EIS method is based on the periodic driving signal – the alternating signal. If the low amplitude of the alternating signal is used, concentration changes of charge are minimal at the surface of an electrode connected with measurement, which is very important in systems sensitive to so-called concentration polarization. The range of frequencies used of the driving signal enables the characterization of systems comprising more interconnected processes with different kinetics.

In the Laboratory of Water-Management Research of the Institute of Water Structures at the Civil Engineering Faculty of Brno University of Technology, a measuring instrument with a Z-meter III device has been developed within the solution of the international project E!4981 of the programme EUREKA (a part of the Czech researcher of the project bears the designation OE 10002). This instrument is verified in laboratory experiments and measurements on objects *in situ*. Phenomena identifiable by changes in impedance, which take place in a porous environment (soil, stone masonry), are investigated.

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IMPACTS FROM WASTE DISPOSAL SITES TO SURFACE WATERS

The quality of water directly impacts the quality of our lives. Contaminated water eliminates drinking water supplies, degrades recreational water resources, and destroys wildlife habitats. The waste disposal sites impact the water quality through runoff and percolation. This paper deals with description of impacts from legal and illegal waste sites to surface water in the Republic of Macedonia. Certain site conditions, such as steep and unprotected slopes, lack of vegetative cover, and lack of proper waste management, encourage the pollution of water and watershed. Collection, transport and landfill are the main methods for final disposal of almost each waste fraction. In Macedonia only approximately 70% of the population is involved in public municipal waste collection system. Collection of non-separated municipal and non-hazardous industrial waste, as well as non-separated hazardous waste fractions is common practice.

Roughly estimated yearly generated waste by type, source and quantity will be presented, as well as generated waste projection. Municipal landfills risk categorization on the environment, impacts and a review of the key problems related to the existing waste management will be discussed. Some outcomes from CARDS Project for development of the National Waste Management Plan (NWMP) will be presented.

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THE STATE OF THE RUBBLE MOUND BREAKWATERS' PRIMARY COVER LAYER IN ISTRIA

The paper addresses the field investigation conducted to define the condition of the primary cover layer of six Adriatic rubble mound breakwaters on the western shore of Istria. A few characteristic profiles were recorded on each breakwater, 3,5m wide from the crest downwards to the sea level line on the slope. The dimensions (mass), as well as interlocking blocks were measured by means of a mutual contacts number. The granulometric curve of each profile's primary cover layer was defined basing on the recorded data. The real value of Hudson's layer coefficient K_D was estimated on the basis of contact statistics and transformed Hudson's equation. The significant wave height in front of breakwater (i.e. in shallow water) defining the breakwater's stability was determined for each location according to the Hudson's equation, with the known mass of 50% represented block, and estimated value of the layer coefficient K_D. The shallow water wave height obtained in this way, considering the wave deformations, was transformed into equivalent deep sea water wave height by the calculation of shoaling and backward refraction. The wave return periods resisted by the mentioned breakwaters were obtained by inputting wave height, defined in above mentioned way, into own maps of long term wave climate for the Adriatic.

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THE ASSESSMENT AND FORECAST OF SEDIMENTATION AT THE NOVE MLYNY RESERVOIRS

The issues connected with dam reservoir sedimentation are becoming more and more topical. The estimation of current sedimentation and the forecasting of future decreases in reservoir volume is a routine procedure for dam owners. In the paper a method of current state and sedimentation progress assessment is demonstrated for the middle reservoir of the Nove Mlyny water reservoir system. The effect of various factors influencing the sedimentation process is discussed as well.

The Nove Mlyny dams and reservoirs are located in the South-Moravian region in the Czech Republic. The system was completed in the year 1988. The scheme consists of three reservoirs with a total reservoir volume ca 134 mil. m^3. The reservoirs are situated at the junction of three significant Moravian rivers – the Dyje, Svratka and Jihlava – which contribute a considerable amount of sediment mostly to the middle reservoir. The most significant sediment deposits are therefore located in the area downstream of the confluence of the Svratka and Jihlava rivers. During extensive floods and high entrance velocities in the confluence reach the sediments are transferred further into the reservoir area. A small portion is flushed down to the lower reservoir, where normally the water level is maintained approximately at the same level as at the middle reservoir.

In the paper the current sediment volume has been estimated with the use of data obtained from echo-sounder measurements carried out in the years 1994 and 2004 and processed by GIS techniques. For the real values of sediment load during the period 1981 to 2004 a 1D sediment transport model of the mouth reaches of the Jihlava and Svratka rivers and a model of sedimentation in the upper reservoir (where the Dyje River inflows) were calibrated. The forecast of future reservoir sedimentation included a comparison of results obtained from various methods developed by Brune, Churchill and Borland. The analysis was carried out for various reservoir water levels. The results obtained by Churchill and Borland's approaches show relative agreement with a difference of about 20%; the technique developed by Brune gives an approximately two times smaller annual average sediment input into the middle reservoir. The analysis shows that for the present water level (170 m above SWL), the sedimentation of one half of the total reservoir volume will take about 80 years.

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FLOOD RISK ANALYSIS METHODS USED IN THE CZECH REPUBLIC

The flood risk analysis methods are currently used in the flood management procedures worldwide. Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (the Flood Risk Directive) signifies that flood risk analysis methods are gaining ground in EC Member States and thus also in the Czech Republic. Procedures of flood risk analysis have been developed in the Czech Republic since the catastrophic floods of 1997 in line with worldwide trends and have been tested and applied in hundreds of case studies to date. Currently, the Flood Risk Directive Guideline based on past experience with flood risk analysis applications is being processed.

In the paper flood risk analysis procedures and specially developed techniques for the assembly of flood hazard, danger and flood risk maps are presented, methods related to flood risk management plans are mentioned as well. The particular problems like an application and extension of the “danger matrix” approach, the definition of residual danger, the formulation of efficiency criteria and preliminary multi-criteria flood risk assessment are also discussed. Present experience provides evidence that the flood risk analysis methods used in the Czech Republic are in harm with the requirements of the Flood Risk Directive. The proposed and applied methods are based primarily on existing available data such

as flood extent maps, cadastral maps, the Register of Census Districts and Structures and others.

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MEASUREMENTS ON THE INTAKE STRUCTURE OF THE DOBROHOŠŤ SMALL HYDROPOWER PLANT

Paper describes measurements on the Intake Structure of the Dobrohošť Small Hydropower Plant, which had been realized during several stages of hydraulic research – field measurements, measurements on hydraulic model. This research was preceding the construction of this small hydropower plant.

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DESIGN AND CALCULATION OF TANKS ON THE SEWER IN SLOVAKIA

A sewer tanks on the sewer system perform important role. In dependence on type of the sewer system they can be divided into – combined (CSS), separate (SSS) and functions for which they are intended. In general sewer tanks are used for the protection of water course before their pollution, and also for temporary accumulation of waste water (WW) and transformation of maximal flow into the waste water treatment plant (WWTP). Some types of tanks retain only lightly polluted surface water and provide its infiltration into ground water.

Retention tank (RT) is designed on rainwater sewerage SSS. It is used for permanent retain of whole volume of lightly polluted water from surface runoff (rain water) and their consecutive infiltration. Convenient geological situation and sufficient depth of the ground water level below the bottom of the tank is required.

Detention tank (DT) used for temporary retention of water and for reducing of maximum flow rate of mixed water or rain water to required value, whereby whole entrapped volume of water gradually flows further into sewer system. DT is designed in the CSS and the SSS.

Tanks associated with sewer overflow (TSO) are designed at sewer CSS to protect the receiving water, they fulfills the function of accumulation and treating (they retain settleable and floating particles and allow their flow to WWTP).

Sedimentation tank (ST) are designed and operated in area of the WWTP.

Calculation of required tanks volume depends on their type and size of sewer area. Modern methods use in calculation of rainfall-runoff simulation model of runoff. For calculation of the tanks volume on small sewer catchment area is this method in regard to the necessary calibration relatively expensive and gives the necessary calibration and verification of models it is also technically difficult. Therefore for small urban sewer catchment area are used graphic or simple modifications of rational method with application of block rainfall with specific periodicity (RT and DT) or with application of limited rainfall (TSO).

Design of sewer tanks on sewer system in Slovak condition it is given by legislative: Government Regulation (Nariadenie vlády SR č. 296/2010 Z. z), by which are given requirements for achieve good water condition. Basic technical regulation for the design and dimension of sewer tanks on sewer system is STN 75 6261 Storm water tank, the principles of calculation ST are given by STN 75 6401 Wastewater treatment plants for more than 500 PE. The article contains the main allocation of objects and characteristics of sewer tanks. Some chosen design methods of these objects recommended in the applicable technical standards and procedures for design tanks for SR conditions were published by author.

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NUMERICAL MODEL FOR TWO-PHASE FLOW THROUGH POROUS MEDIA

Numerical simulation of multiphase flow through fractured rocks is important in many branches of science and engineering. Hydrologists, agricultural engineers, soil physicists have for many years been concerned with fluid movement in air-water porous media systems. In the most recent years, environmental concerns and search for secure atomic waste depositories and for remediation strategies for contaminated aquifers raised more interest in the movement of fluids in the unsaturated zone interposed between the atmosphere and the groundwater (saturated zone). Many potential groundwater contaminants are introduced near the soil surface via atmospheric deposition, spills, leakage from underground tanks, subsurface waste disposal, etc. Two-phase flow consists of two flowing fluids, which do not interchange mass and do not have reaction with the solid matrix. The equations governing the two-phase flow of fluids are special cases of general balance laws. From numerical point of view, due to the high nonlinearity of the governing equations and their strong coupling, the simulation provides a challenging numerical problem, even when simplifying assumptions are invoked (elimination of the equation of the gas phase, for instance). A new numerical scheme based on the boundary element dual reciprocity method with multi domains (BE DRM-MD) for the numerical simulation is presented. The efficiency of the method is proved on one and twodimensional two-phase flow examples.

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NUMERICAL AND PHYSICAL SIMULATION OF A RIVER BEND FLOW

Hybrid modelling is becoming a more and more common tool in hydraulic engineering. Through a synergy of physical and numerical models, it is possible to benefit the advantages of both methods. Namely, the results can be achieved more quickly, they are more reliable, and the simulated processes can be observed in a more detailed way. In the following paper, a research study on flood protection measures in a river bend of the Enns River in the Steyr town, Austria, is presented. The study has been carried out simultaneously, on a physical and on a numeric model. Thus, the fix-bed physical model at the scale 1 : 70 and a two-dimensional numeric model, *Hydro_AS-2d*, were used. The implemented algorithm is based on the numerical solution of the 2-D flow equations with finite-volume discretization.

The aim of the research was, above the final design of effective flood protection for the particular town district, also to find out, how appropriate is the application of a 2-D numeric model for the simulation of open channel bend flow. Nevertheless, it was of the interest to verify the results of the numerical simulations on the physical model and vice versa, as well as to optimise the entire re-

search procedure. As known, a river bend flow is usually characterised as 3-D flow and the simulation of such processes could be made easily by a 3-D physical model. During the calibration tests, it has been found out that the numeric model reproduces reliably the measured data over the entire model flow field. Hence, by the numeric simulation it was possible to get quickly the essential information for the persistent developing of feasible flood protection measures. In that way, particularly the extensive modifications of the flow field shape could be tested and optimized. Thus, only the promising designs were tested and finalised on the physical scale model. Furthermore, a physical model allows the observation of the flow processes in real time. Thereby also the impact of flow directing structures can be followed and easily adjusted. Thus, comprehensive flow changes are simulated by the numerical model, flow directing measures are tested and improved on the physical model and the integral solution is verified through the physical test runs. The hybrid model simulation method offers a considerable support to a hydraulic study and optimization of the experimental procedure, due to the possibility of testing various designs by the numerical simulations in short time, and reliable checking of the solution on the physical model.

Ultimately, this project shows that the simultaneous use of numerical and physical models can upgrade the hydraulic experimental expertise essentially.

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SUSTAINABLE RIVERBANK EROSION MANAGEMENT APPROACHES FOR ALLUVIAL RIVER CORRIDORS

Riverbank erosion is a result of complex interaction of highly variable natural processes dependent upon the hydraulic features of the riverbed and the physical features of the riverbanks. It is often perceived by society as a major management concern, especially in alluvial corridors. The negative effects of riverbank erosion include loss of land and associated resources, damages to property, infrastructure, and other. It is therefore considered as a natural hazard which needs to be prevented.

There is considerable experience when it comes to applying traditional riverbank stabilization techniques, consisting mainly of construction and bioengineering interventions. However, they are currently being reconsidered as a result of increased understanding of the adverse effects of their application and instead, new management approaches are being developed. It is nevertheless important to recognize that besides its negative effects, riverbank erosion has also proven to be higly valuable for ecosystems, and this needs to be taken into consideration in the cost-benefit analysis evaluating the feasibility of alternative riverbank management approaches.

This paper focuses on the new riverbank management approaches adopting the idea of allowing the river to migrate freely within a defined corridor, in which

the property rights will be specially regulated. In litterature, this concept has been given different names: erodible corridor concept (ECC), stream corridor, riparian corridor and other. The paper provides an overview of the ECC as an alternative to the traditional riverbank stabilization works, and analyzes the possibilities of its practical application. It also discusses the limitations of its application, depending on the local context. Some methods for determining the zone of the river's lateral mobility, which presents the most important element of this innovative approach, are also elaborated. The river basin scale is suggested as the most appropriate one for identification of the potential restoration sections and targeting priority action. The use of such a scale not only has a geomorphological reason, but also presents the most suitable framework for decision-makers to implement the integrated river basin management concepts, widely incorporated in the national legal systems of many European countries, in compliance with the EU Water Framework Directive.

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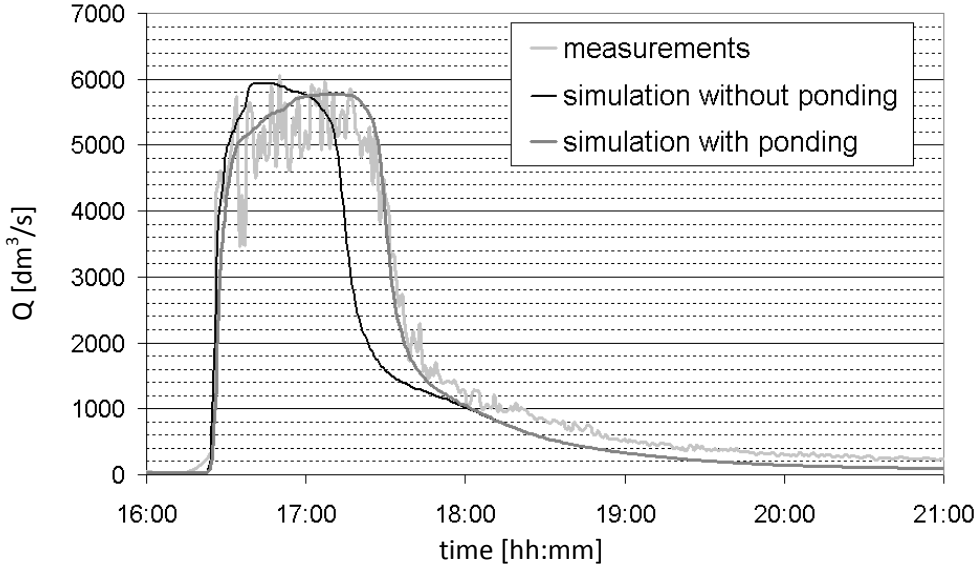
SIMULATION OF RUNOFF FROM URBAN CATCHMENT WITH REGARD TO STORM SEWER SURCHARGE

According to EU recommendation different scenarios of storm sewers surcharge should be taken into account by analysis of sewer network performance. Presented analysis contains a comparison of results of runoff simulation obtained for scenarios with and without ponding of excess overflow.

Simulations were performed applying rainfall-runoff model SWMM-5 for a catchment of almost 7 km^2 situated in the city of Poznan (Poland). It is covered mainly by dwelling houses constructed after the II World War for which the coefficient of imperviousness was evaluated as 29%. The catchment is drained by storm sewer network consisting of 82 *stages* collecting water from 55 partial catchment. Rainfall data used for simulation were recorded by 2 tipping-bucket raingauges in years 2006 – 2008. For each of 42 rainfall events selected from this period a runoff from specified above catchment was computed using the calibrated model SWMM-5. Historical rainfall data were used by simulation of runoff from a real catchment. The first stage of analysis is based on comparison of hydrographs obtained for different scenarios of sewer surcharge, the second (only for real urban catchment) – on a comparison of simulated hydrographs with measurements (Fig). It was found that terrain configuration over surcharged sewer – mainly possibility of water collection in surface depression – and the surcharge scenario have a large influence on adjustment of simulated hydrographs to measurements.

Last section of the paper contains evaluation of considered scenarios taking into account a practical aspect of water collection in surface depressions.



Comparison of simulated hydrographs with measurement

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MODELLING METHODS OF LANDFILL LEACHATE

Waste disposal facilities are mainly responsible for the gradual quality degradation of groundwater. In general, we can say, that water seepage from landfills pollutes water resources. The main problem of pollution is the potential migration of leachate seeping into the groundwater.

The flow of water through the landfill of municipal waste is very non-uniform. Thus, concept to simulate landfill behavior requires that a heterogeneous flow regime is considered. Recent models are based on a 2-domain approach, differentiating between channel domain with high hydraulic conductivity and matrix domain of slow water movement with high water retention capacity. These models focus on the mathematical description of rapid water flow in channel domain.

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MINIMALIZATION OF SOLID WASTE LANDFILLING BASE ON WASTE ANALYSES

The waste landfilling is the worst alternative of waste disposal. We can say, that this is not the waste disposal, but only the moving the problem solving into the future. If we want to dispose the wastes, we must take consider on waste specific, we must respect the waste material. The way out of this problem solution must be base on system waste analyses, which is not easy. We must do serious analyses with the mathematical equation using as a computer software basement, which can give us the answers, how to effectively dispose the waste. The only separation and recyclation, or waste reclamation is the right way, special the reuse of waste through the waste cycle.

The paper focuses the waste analyses as the base for the future aim, to minimalize the landifills with the aim to environmental protection.

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SENSITIVITY ANALYSIS OF NUMERICAL WATER QUALITY MODEL CONSIDERING TO THE DISPERSION COEFFICIENT VALUES

Hydrodynamic model simulating a pollution transport in open channels requires a number of input data, but on the other hand these kinds of models simulate water quality in surface waters more detailed. As an input data there require among other data also dispersion coefficients. Determination of dispersion coefficient values has one of the highest extents of uncertainty.

The reliability of models is influenced by the fact that the numerical simulations mean always a simplification of the complicated natural conditions. Finally the rate of reliability is closely connected with the level of input availability and validity.

This paper is connected with authors' previous research work, which was focused to determinate the dispersion coefficients in various hydraulic conditions (natural conditions, artificial conditions, e.g. sewer network) and it shows the importance of use of proper and reliable data in modelling studies. A result comparison and sensitivity analysis using different approaches and datasets will be presented, together with analysis of available data values.

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ANTHROPOGENIC INFLUENCES ON WATER BALANCE IN URBAN AREA

Hydrological characteristics of urban area are heavily modified related to the natural catchments. Higher part of paved areas causes faster runoff process, the travel time of rainwater is much shorter, as well as the runoff volume is bigger than in natural areas. Sewer network transports higher storm water volume in shorter time: this causes higher hydraulic load on the sewer network and following CSO. Important role in this process play also anthropogenic influences. These significantly change the water balance in urbanised catchments with addition of new water (and pollution) sources or with water transfers between particular hydrological subsystems (both natural and artificial hydrological subsystems – water supply network, sewer network).

Because of these reasons it is desirable, that these negative influences will be reduced to minimum. The goal is to achieve the hydrologic characteristic of the urban catchments alike the characteristics of the natural catchment. Proposed paper will present results of a cause study, expressed in form of a system chart of the water balance. Analysed urban area has very complicated relations between particular subsystems (high exfiltration rate from the water supply network as well as high infiltration rate into the sewer network, interactions with surface and underground water). Hydrological function and impacts of particular system ele-

ments will be analysed as well as different possible management scenarios. Important parts of the analysed problems are not economical and financial aspects only, but also technical and environmental aspects regarded from the point of view of the integrated water resources management. Last but not least are also very important technical impacts, which can prevent efficient and safe operation of the water supply and sewer networks.

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EFFICIENT USE OF GIS APPLICATIONS IN WATERWORKS SECTOR

GIS – Geographical Information System, defined as a tool for computerized collection, manipulation, processing, analysis and graphical presentation of spatially distributed data. This system includes geometric data (coordinates, points, lines, planes/areas and topological data) and their attributes, thus information which further describes properties of geometric structures. Attributes can be alphanumeric, or graphic, for example sections, photographs, etc. GIS contains tools for manipulation of both types of data – i.e. graphic data (graphic editor) and alphanumeric data (databases, graphic editor, according to the type of attributes) and of course tools for creating connections between the both types of data.

A GIS system represents very useful tool for the waterworks companies and operators. But no GIS systems can collect the necessary data itself, similarly, no GIS system can update the data – this is a long – term and exhausting task for the GIS operators. On the other hand, the advantage of a GIS application (if a complete and reliable data is present in the system) is a very simple, efficient operating and decision supporting tool.

Despite all advantages of the GIS systems, in Slovak waterworks companies are the possibilities of the GIS systems not efficiently used, however practically in

all waterworks companies are GIS systems used. Problem is, that the level of the used GIS system is very doubtful, as well as the data quality and reliability. In many cases the presented “GIS” solution is only a digital map, without further data or connected database. Such application does not allow system analysis, e.g. hydraulic load of the network, construction status of the pipes and objects, rehabilitation planning etc.

This paper will analyse problems, which occurs during the GIS implementation in waterworks companies in Slovakia. Further a necessary (minimal) extent of data will be discussed, data collection methods and reliability checking, update procedures as well as possibilities of data analysis (incl. external analytical tools) and economical aspects of the use of GIS technology.

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VARIABLE PATTERNS OF EVAPOTRANSPIRATION IN A PROTECTED WETLAND CATCHMENT INFERRED FROM SATELLITE REMOTE SENSING AND METEOROLOGICAL DATASETS

A quantification of water resources available for ecosystems is a prerequisite for any water management practices. In case of water sensitive environments this issue is of the primary importance. In temperate regions where precipitation recharging the soil water and groundwater resources is highly variable in space and time, the quantification of water available for ecosystems remains an important issue. Given the importance of green and white water fluxes for the maintenance of natural ecosystems, a fundamental understanding of their quantities and dynamics is required.

This research aims at increasing the understanding of the dynamics and spatial patterns of evapotranspiration at a catchment scale where valuable wetlands require protection and/or regeneration. Such environment needs environmentally oriented water management approach one of which is sustaining or restoring the water regime. Elaboration of reconstruction methods of former water conditions in the catchment requires the identification of current hydrological processes, in them evapotranspiration, as a starting point for implementation of restoration measures. The investigated catchment is located in the central part of

Poland, on the Mazovian Lowland, within boundaries of the Kampinos National Park and covers the area of about 363 km^2. Within its boundaries there are wetlands of international importance belonging to the UNESCO Biosphere Reserves.

Spatial and temporal patterns of evapotranspiration as well as vegetation indices were investigated. Evapotranspiration estimates produced with the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor were acquired from GSFC NASA and utilized at a spatial resolution of 1 km and temporal resolution of 8-day. The algorithm of the MODIS evapotranspiration is based on the Penman-Monteith equation. Remote sensing inputs include variable leaf area index and enhanced vegetation index. The product MOD13A3 was reprocessed into monthly composites using a weighted averaging method. The analysis covers the period 2001–2006. As a background for remote sensing images, potential and actual evapotranspiration were calculated at a monthly time step based on the meteorological measurements conducted in ground base stations. The evapotranspiration rate was derived for wet and dry conditions. Environmental variables, such as vegetation characteristics, controlling the processes involved in evapotranspiration, were analyzed. By quantifying their temporal variability, it was possible to analyze relationships describing how evapotranspiration varies with changes of vegetation indices. While the relationships between the evapotranspiration and environmental variables are complex, soil water resources in particular play an important role in controlling the amount of green and white water transferred into the atmosphere considered here together as evapotranspiration.

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COMPUTATIONAL ADVANCES IN SEWER SYSTEM APPRAISAL

The ability of sewer system appraisal, and sewer system design growed up very extensively in last time. If is it the advantage or no, this is not only technical, but approach question, too. The present exact system of sewer system evaluation has excited us, but we must know, that our goal is to reach the reality mirror. This imagine of reality, on the other side, is able to solve the present condition of the specific sewer system problems, but this don't know to answer the future asked questions. The historical approach tried to solve the problems many years into the future, because the hard work was needed to build the solutions. Example is the sewer system of London, or Paris, built many years ago, with the relatively good condition to this time with the capacity and very often quality too.

The paper describes the new approach of hydro-dynamical sewer system appraisal comparing the rational method applied in computational software, which is possible to use not only for sewer system evaluation, but sewer system design too, based on graphical background.

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THE ALTERNATIVE SEWER SYSTEM DESIGN IN FLAT AREAS CONSIDERING SEWER TYPE

The West and East part of Slovakia are significant with the flat areas. This type of surface need special approach concerning the sewer system built, because this area type offers various sewer network solutions. The very important in the sewer system design is to keep the design principles, which are attacked by the investor press, with the goal of the sewer system price decrease. The conflict between investment cost and on the other side, operational costs and operational conditions must consider the design principles. The alternative sewer system design is allowed, such as gravity and vacuum system, but it is strictly recommends to prove the validation of designed system. The consideration on the fact, that the sewer system will be operated by the municipality is very important. The very important influence on the sewer system design has the EU promised, which make a press for the fast sewer system built in Slovakia, which could be decrease the quality process of designing. The paper offer the solution, how to solve these problems, respecting the proper design conditions.

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HEURISTIC OPTIMIZATION METHODS IN THE PROCESS OF WATER MANAGEMENT – ENERGETIC PLANS FOR REGULATING HYDROPOWER PLANTS

Regulating hydropower plants are significant regulating part of electric supply systems. These power plants are above all mounted to cover the variable load. Hydropower plants are also exploited as failure backup of the network (performing the ancillary services). The efficiency of regulating hydropower plants dynamic properties are close related with optimization methods applied in the process of water management–energetic plans development. Presently the most significant optimization techniques are heuristic methods (genetic algorithms, simulated annealing, harmony search and others). Heuristic methods are basically searching methods controlled by defined strategy and are useful for the searching tasks which do not have any adequate specific algorithm or eventually direct numerical method. The goal of this paper is to describe the opportunities of heuristic optimization methods in operation planning of regulating hydropower plants.

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COMPARISON OF DIFFERENT METHODS FOR CALCULATION OF HIGH WATER HYDROGRAMS ON SMALL, INSUFFICIENTLY ANALYZED WATERSHEDS

Current engineering practice often requires hydrograms calculation of high waters in watersheds that are not sufficiently analyzed. Accuracy and reliability of calculation results depend of: precipitation data, physical, geographic and other characteristics of the watershed, geometry of river valleys and use different methods to describe the processes in the transformation of effective rainfall to runoff. Processing of physical and geographic characteristics of watershed and preparation of spatial data related to geometry of river valleys and waterways are simplified by using digital elevation models and GIS tools. For calculations of high waters hydrograms mathematical models are used, which model precipitation-runoff ratio on a basis of data of runoff and watershed area characteristics.

This paper will show calculation of hydrograms of high waters of small, insufficiently analyzed, mountain watershed. GIS-tools are used for preparation of watershed characteristics data. According to obtained data about watershed and precipitation, and with use of hydrological model, hydrograms of high waters are calculated, with use of different calculation methods for precipitation-runoff ratio. For this study, we give a comparative analysis on the advantages and disadvan-

tages of each method. By comparison of obtained results with regionally developed methods, factors are obtained, for methods which better describe precipitation-runoff ratio in insufficiently analyzed small, mountain watersheds.

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THE INFLUENCE OF HYDROLOGICAL HAZARDS ON THE UEFA EURO 2012 FOOTBALL TOURNAMENT RUN IN GDANSK

The final tournament of European championships in football is organized by Poland in cooperation with Ukraine in June and July 2012. Three group matches and a quarter-final match of EURO 2012 will be held in Gdansk. For this special event a new stadium having the capacity of more than forty thousand funs is building in Gdansk Letnica. The success of the Euro 2012 football tournament depends not only from accommodation conditions and from the network of roads and railways, but also from hydrological conditions in the Gdansk river network. The latter are mainly due to the meteorological situation during tournament.

In this paper the climate of Gdansk analysis based on meteorological data and scientific publications from the years 1950 to 2010 is presented. The results of weather observations noted in Gdansk University of Technology climate station were especially taken into account. The reason is, that this station is the closest one (2,3 km) from Gdansk PGE Arena.

The influence of extraordinary meteorological facts, which occurred in Gdansk in the decade 2001 – 2010, on the river network in the whole Gdansk agglomeration was determined. The probable impact of the extreme weather conditions on Euro 2012 events was also discussed.

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NUMERICAL RECONSTRUCTION OF RUNOFF FROM UPPER STRZYŻA DRAINAGE BASIN BEFORE NOWIEC II RESERVOIR FAILURE

The paper concerns numerical simulations of runoff from upper Strzyża drainage basin during the rainfall event resulting with Nowiec II reservoir dam break on September 2010 in the Gdańsk quarter called Matemblewo. The aim of the work is to present the hydrological rainfall - runoff model which was used for reconstruction of reservoir inflow hydrograph due to real precipitation.

The Strzyża Creek is a natural stream that flows from the Gdańsk moraine hills and which supplies the Dead Vistula and finally flows to the Baltic Sea. The stream also performs the function of the rainwater and snowmelt collector. The large urban expansion in the direction of moraine hills is observed in the last half-century in the city of Gdańsk. The catchment transformation causes an acceleration of surface runoff, increase of discharge in the Strzyża Creek and its tributaries. The change of hydrological nature of the catchment has resulted with an increase of the flood risk in the city due to limits of stream conveyance and reservoirs capacity.

The object of this study was to determine the runoff from the basin of the upper section of the stream during the real intensive rainfall. The entire episode

of recorded rainfall lasted from 27 to 29 September 2010, and the aggregate amount of rainfall in this region reached a value of 90.2 to 150.4 mm. The intensive outflow from upper Strzyża basin caused the failure of the earth dam of Nowiec II reservoir and sudden outflow in the Gdańsk Wrzeszcz quarter direction. As the model of rainfall - runoff transformation the SCS curve method and SCS unit hydrograph were used for estimation of precipitation loss rates and outflow, respectively. The HEC-HMS computer model was applied for numerical simulation of runoff from upper Strzyża drainage basin.

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METHOD FOR DETERMINING THE OPTIMAL SOLUTION FOR DISPOSING OF WASTEWATER IN THE UPPER COURSE OF RIVER TRESKA

In this paper we present methods for determining the optimal solution for capturing and treating waste waters from six municipalities in the Southwest region of the Republic of Macedonia. For choosing the optimal solution made several conceptions of the sewage system: system with central wastewater treatment of all settlements, partially decentralized system of purification of waste waters from settlements and totally decentralized system for wastewater treatment. Criteria that were used to optimize the system are: economic (minimum of capital and operational costs and benefits of the system), compatibility of the system, reliability and flexibility of the system, Environmental Protection, energy efficiency of treatment plants, treatment of sludge from treatment plants, automatic control system, etc. The optimal solution is selected from the analyzed variant solutions of the system using multiple criteria optimization.

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RISKS OF DANUBE SOURCES EXPLOITATION IN CONTEXT OF RAPIDLY DEVELOPING CAPITAL CITY AND ITS ENVIRONMENT

One of the basic requirements of accession negotiations for the Slovak Republic was to increase the level of care for the environment so as to comply with EU environmental standards and especially with the EU Water Framework Directive. The task to ensure a higher level of water supply is closely linked with issues of exploitation and protection of water sources, particularly in terms of their uneven surface distribution. Slovakia has high quality water resources of groundwater in the alluvial area of the river Danube, which has a cross-border character. These waters are used to supply a wide deficit area out of Danube basin. Bratislava Water Works, which operates on a wide territory around the capital city, executes strategically most important abstractions of drinking water from this area. Large-scale water sources of alluvial Danube area are used not only for the capital city, but they are also considered to be a possible water source which can be used in the whole region, outstretching to several districts.

Recently, water sources especially for the city of Bratislava and its wide surroundings are being strategically discussed, as conceptually large water systems should be formed. Various reports on investment interests in protected areas of water resources, which could mean a real risk of deterioration of water resources, are a reason for recent professional and political discussions.

The Bratislava example of usage and potential impact of a depreciation of any strategic water resources of Žitný Ostrov – the largest reservoir of drinking water in Central Europe – will specifically used to visualize the seriousness of a problem in this strategic region. Experience from the water source collapse clearly supports the fact that contamination of water resources is irreversible.

The Danube region is moving towards large developments despite the current economic crisis and it seems that the development shall not stop in the near future. The potential of large-scale water resources of the Danube basin in Žitný Ostrov is therefore strategically important for the future. The reserves in the water sources´ balance – as of the optimistic variant of an increased supply connection and future water demand are minimal, and as it can be seen from the above-mentioned factors, a failure of any of these strategic sources could mean a serious threat to coverage of our future needs.

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MATHEMATICAL MODELING OF COMBINED SEWER SYSTEMS

This paper analysis the main aspects related to mathematical modeling of combined sewer systems. The paper is focused on definition of basic parameters used to describe runoff. Definition of subcatchment area is analyzed with special concern on all relevant parameters that define each particular subcatchment area. In combined sewer design practice, many different nearby subcatchment areas are often described as one with average values of certain parameters (runoff coefficients, infiltration rates, etc.). The reason for such practice is to simplify the overall calculation procedure. Within this paper, the original methodology of defining big subcatchment area instead of few smaller ones will be analyzed. The justifiability and reliability of such practice is investigated regarding the quality of output values of certain hydraulics parameters inside the sewer network. Additionally, from the critical point of view, conventional method of runoff calculation will be explained and valued in comparison with the mathematical modeling capabilities. One of the key parameters that will be explained in detail is runoff coefficient. The main issues of given analysis will be explained using EPASWMM (version 5.0) mathematical model. Specific example that describes the real conditions is created, with calibration procedure included based on available measurements data.

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PRESENTATION IN THE APPLIED HYDRAULICS

Trying to speak of something as messy as communication in technical terms seems to be another, that is, math and science and technology are the answer to all of our problems. The purpose of a presentation is to inform a certain number of staff or interested parties about subject matter and circumstances. It differs from an address in that the appeal is not to the listeners emotions, but to their intellect. Facilitation is a type and method of group discussion. The aim is to involve the participants actively and to focus them on their objectives. The Facilitation Method is a system of techniques and individual methods for the implementation of facilitation and infomarkets. The main elements are: visualisation, group question techniques, work in plenary and small groups. The Factors to be considered when preparing a Meeting or a Workshop are: Type and objective of the workshop, available budget / who sponsors (might sponsor) the conference? / ceiling allowances, conferences fees, official permission to hold the workshop, selection of participants (if possible use criteria), consider all related institutions, groups and persons. As a part of CPSP (Country Policy Support Program), a Basin Wide Holistic integrated Water Assessment (BHIWA) model was developed. The model has seven computation modules. In addition to these moules, there are worksheets to facilitate data inputs, and generation of aggregated results in the form of tables and charts.

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THEORETICAL AND EXPERIMENTAL ANALYSIS OF CORRUGATE GRAVITY PIPES

In this paper the authors present a theoretical and experimental analysis of the bearing capacity for buried corrugate pipes. The analysis is based on German ATV-A127 method. In order to express the pipe ring stiffness, the moment of inertia of the pipe wall section and mean pipe diameter for corrugate pipes are defined. A numerical example is included to demonstrate the potential of the analytical model. The calculation results are compared with the experimental results.

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NPSH FOR CENTRIFUGAL PUMPS

This paper deals with centrifugal pumps cavitation, discussing the concept of net positive suction head available (NPSHA), net positive suction head required (NPSHR) and safety margins between NPSHA and NPSHR. In connection to NPSH several phenomena and other characteristic cavitation parameters also are discussed, including pump and pump suction piping characteristics. Furthermore, guidance for prevention of cavitation in centrifugal pumps also is given.

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SELECTED ASPECTS OF SIMPLIFIED RUNOFF CALCULATIONS IN URBAN CATCHMENT

The presentation is devoted to selected aspects connected with simplified estimation of urban catchment runoff, with special respect to the influence of simplifications to the results of calculations – their accuracy and relativity. Special attention is paid to the question of the time of concentration – the methods of its estimation for the purpose of simplified engineering calculations and the influence of the chosen method to the obtained results, especially related to the consequences in dimensioning of rainwater drainage systems.

The aim of the presentation is to present the popular in Polish calculation approach to the question of rainfall duration estimation for urban catchments and its consequences of the formal and computable nature. In the presentation the most important features of urban catchments and the specificity of the Polish approach to the drainage systems dimensioning are presented. The emphasis is paid to the characteristic lack of consistency between the two approaches: typically engineering and more formal (scientific). In the presentation the question of the influence of the choice of the simplified method of runoff calculation (including time of concentration estimation) to the results are discussed.

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ANALYSIS OF THE BEARING STRUCTURES OF DIVERSION TUNNEL (poster)

The tailing dams are specific structures with high level of risks on the environment. The risks are connected with possible contamination of the ground water, air pollution and extreme consequences in cases of eventual failure.

This paper deals with analyses prepared for a tailing dam which is a part of all systems in a frame of lead and zinc mine "Sasa" in Makedonska Kamenica. Formerly, tree tailing dams were constructed, and they are used for deposition of the waste material obtained by the technological process of flotation of lead and zinc minerals till present moment. During 2005, a specific collapse at the area of Dam Lake had happened, connected with destruction of the diversion tunnel. The reasons for the collapse are presented briefly in the paper.

After that, starting from 2007, the tailing dam 3 is in a phase of construction, and the safe exploitation is insured with remediation of the old and construction of new section a new diversion tunnel.

Now, the process of design of tailing dam no 4 is in progress, so some elements of the technical solutions are given in a frame of this article. Briefly, geological and geotechnical elements of the environment are explained.

A review of the key problems related to the design of diversion tunnel, possible environmental influences from the new tailing dam are also discussed.

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MATHEMATICAL MODELING OF DISSOLVED MATTER TRANSPORT WITH BIODEGRADATION IN NATURAL AND ARTIFICIAL CONDITIONS

Water as an essential element of the ecosystem of the planet, always contains some admixture of various substances and microorganisms. If you have them in abundance, we can talk about the pollution, which can be disposed of in a process called purging. This phenomenon may be either natural or artificial. As it occurs naturally in rivers, where at low load of pollutants we are dealing with self-cleaning process. It is mainly a distribution, dilution and detention by the environment of substances contained in water. Through this process, small portions of impurities are removed in a natural way, without causing harm to the environment. Purification processes may also be forced artificially by humans and relate to contaminated water, or sewage.

Ability to perform the simulation of solute transport with biodegradation involves the potential use of mathematical models and computational methods. On the one hand there are models describing the hydrodynamics of a carrier of pollutants (water) and advective-dispersive transport of dissolved matter - that are physical processes. On the other hand there are models describing biodegradation processes of that substance – that is biochemical processes. In the first case, which is in hydromechanics, the existing equations of mathematical physics

describing these processes are well known and widely used in practice. For the description of the decomposition of pollutants, the problem is more complex and as far as getting to know the nature of these processes, new models are created. Widely used and are currently being developed deterministic models of a new generation - ASM (Activated Sludge Models). These models describe the biochemical changes in the factors determining the stoichiometric ratios of substrates and products of various biochemical reactions and kinetic parameters describing the speed of the processes. These models have been developed to mathematical description of the wastewater treatment processes used in bioreactors for the biological stage of wastewater treatment plants, and can be used to describe the phenomena occurring in the canals and rivers. These models are used as a source terms in solute transport equation to describe biodegradation processes.

The main objective of this work is to apply ASM2d model to describe wastewater treatment processes using activated sludge and to test the results obtained on a laboratory equipped with batch reactors.

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INFLUENCE OF OPERATION PARAMETERS OF WATER TREATMENT PLANT EXPLOITATION ON TRIHALOMETHANE CONCENTRATION IN CHLORINATED WATER

Current water treatment plants contend with difficulties in disinfection process. Namely, during water disinfection using chlorine there appears disinfection by products (DBP), particularly such as trihalometanes (THM). It is connected with the fact that water treatment arrangements are not adjusted to high efficient removal of THM precursors. The concentration of THM precursors in surface water is high and it continuously increases as the result of anthropogenic environment pollution. Therefore it is very important to adapt just existing water treatment arrangement to changing conditions of raw water quality, which decreases the risk of too high concentration of THM generated in drinking water. It is essential because DBP are generated not only in water treatment process but also (mainly) in wide distribution water pipe network. The monitoring of DBP concentration in water supply systems follows that THM have carcinogenic and mutagenic character and they are dangerous for human health. On the other hand, the precise monitoring of THM is expensive so it is limited to indispensable minimal range.

In particular, the process of disinfection by products can be considered in the statistical depiction. Literature review shows that there were only a few attempts made in order to define a mathematical model which describes changes of level of THM formation in time. Models defined until now base mainly on data generated during laboratory research in fixed conditions. Only several of them were specified in research conducted in real water distributions systems, however they differ depending on their location.

This paper presents the analysis and statistical model of DBP forming process in water chlorinated in two water treatment plants, which is delivered to distribution systems of Cracow and Wroclaw city. Basing on obtained results of previous water quality analyses in 2000 – 2005, the mathematical models describing the level of newly arising THM were statistically tested. These models of THMs concentration are a function of basic factors that determine chemical reaction of organic compounds and chlorine. Obtained statistical models allow to define the optimal chlorine dose used in water disinfection process in unstable exploitation conditions. Controlled application of chlorine dose ensures the production of water which does not endanger the consumer's health.

The above models take into consideration changes of water treatment exploitation parameters as well as changeable raw water quality in sources where the water intakes are located. In this paper these obtained statistical models of Cracow and Wroclaw are comparison. The statistically significant results can be a significant tool employed in managements of exploitation of water distribution systems in the aspect of high water quality conservation.

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WATER FROM GDAŃSK TASTES BEST IN POLAND

*DRINKABLE DIRECTLY FROM A TAP

*An independent assessment of water quality in Gdańsk was conducted on 6-7 July 2010 by a water tester, Krzysztof Stankiewicz MCh PhD, and confirmed at the University of Warsaw laboratory. Water from Gdańsk ranks highest in smell and taste among water from 10 Polish cities tested in the analysis.

Complete test results are available on: **www.tester.brita.pl**

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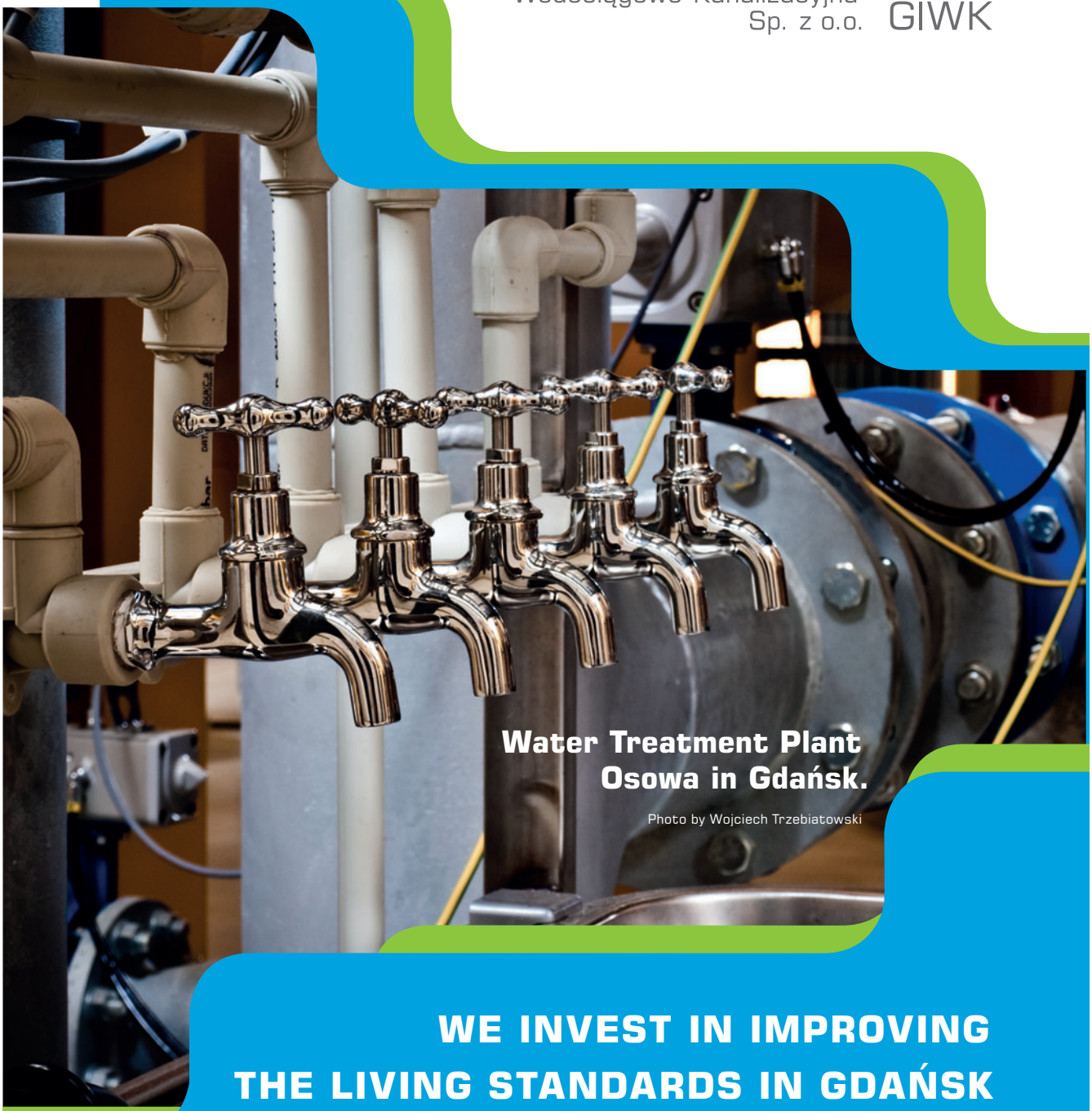

**Water Treatment Plant
Osowa in Gdańsk.**

Photo by Wojciech Trzebiatowski

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