

Scientific and Technical Conference

„Theory and Practice of Current Pumping Techniques“



Conference timetable

8:30 - 9:00 Presentation of participants

9:00 - 9:05 Opening of the conference

9:05 - 12:30 Presentation of professional papers

12:30 - 13:15 Lunch break

13:15 - 15:15 Presentation of professional papers

15:15 - 15:45 Discussion on the papers presented

15:45 - 17:00 Informal discussions with refreshments

17:00 Conclusion of the conference

1 Axial flow pump with annular motor

VUT Brno

prof. Ing. F. Pochylý, CSc.
doc. Ing. M. Haluza, CSc.
Ing. P. Jandourek, Ph.D.
doc. Ing. Č. Ondrůšek, CSc.
doc. Ing. P. Rudolf, Ph.D.

The new axial flow pump with annular motor was developed at the V. Kaplan's Fluid Engineering Department. The pump is designed for rescue teams, for long distance transport of liquids, for pumping liquids from large depths, or to large heights. The pump is of a modular construction that allows it to be connected to hoses or curved flexible ducts. Its advantage is low pressure in pipelines with any distances.

2 Some factors affecting hydraulic design of mixed flow pump

STU Bratislava

**CENTRUM
HYDRAULICKÉHO
VÝZKUMU, spol. s r.o.**

prof. Ing. M. Varchola, CSc.
Ing. P. Hlbočan, Ph.D.
RNDr. M. Sedlář, CSc.
Ing. M. Komárek

The issues of the mixed flow pump hydraulic design is determined primarily by achieving maximum efficiency over a wide flow range, and not less important is to achieve the characteristic stability. The pump geometry is proposed for the so-called design point, and the geometry of the impeller, diffuser and input parts are solved separately. Hydraulic couplings of impeller and diffuser, and/or input parts are important especially with regard to the characteristic and efficiency out of optimum modes. The paper deals with the change in geometric coupling between the impeller and the diffuser (a volute or a blade diffuser) which then predetermines changes of the hydraulic coupling to quantitative course of specific energy, i.e. the Q-Y characteristic, the efficiency and a change of the optimum pump flow rate. It also shows the impact of the impeller input adaptation on the characteristic stability.

3 Utilization of pumping equipment in hydrostatic systems for emergency situations

VŠB-TU Ostrava

Ing. M. Vrábel
doc. Ing. S. Drábková, Ph.D.
prof. RNDr. M. Kozubková, CSc.

The paper deals with a possibility of using a hydrostatic system for rotodynamic pump drive. The design of a hydrostatic circuit is based on the pump optimum parameters obtained by CFD simulation. The performance parameters are then used for calculation of appropriate hydraulic elements, by means of which it is possible to control the entire circuit.



4 **Energy dissipation on
internal joints of plastic
pipeline water feeders**

ČVUT Praha

prof. Ing. J. Melichar, CSc.
Ing. P. Mosler, Ph.D.

The hydraulic design of long pipeline water plastics feeders differs from the design of steel pipe feeders. Pressure losses in the plastic pipeline significantly affect the hydraulic parameters of the entire system. Frequently neglected loss is a pressure loss in the plastic pipeline joint made by butt welding method which does not occur in the steel pipeline. This paper presents results of the research focused on obtaining reliable data on an amount of pressure losses occurring in polyethylene pipelines.

5 **Research of cavitation
effects using acoustic
and optical methods**

TU Liberec

Ing. J. Hujer
Ing. M. Muller, Ph.D.
E. Ofei Aidoo

The paper describes some possibilities of using acoustic, optical and mechanical methods for research of interaction of cavitation bubbles and surfaces of bodies. The first part of the paper discusses the techniques used with the optical and mechanical evaluation of surfaces of bodies damaged due to cavitation. Subsequently, the methodology is presented for evaluating the magnitude of the force generated by cavitation bubbles to surfaces of materials, including the calibration methodology. At the end, the possibilities of using the surface hardening results due to cavitation to determine the intensity of the applied load are discussed. The cavitation is generated in individual cases either by an ultrasonic cavitation generator or by using a high-speed cavitation tunnel.

6 **CFD analysis of the
rotating separation in a
reverse turbine being
operated in pump mode**

**ČKD Blansko
Engineering, a.s.**

Ing. U. Ješě, Ph.D.
Ing. A. Skoták, Ph.D.
Ing. J. Mikulášek

The most efficient ways to store large amounts of energy include pump-storage hydroelectric power plants using reverse turbines. They should respond flexibly to needs of power-generating networks. Therefore, they are subject to rapid transitions between the turbine and pump modes and it could happen they are operated out of the optimum performance range. In order to ensure the stability of the network, no hydraulic instability could occur during their operation. The main source of instability in the pump mode is the presence of rotating separation that occurs when the machine is partially loaded. As a result of rotating separation, the machine can be subjected to large radial forces and uncontrollable jumps between work points. Within a hydraulic design of a new reverse turbine, it is important to ensure the unstable flow area should be outside the normal operating range of the pump mode. In case of transition states when a turbine has to run for a short period of time outside the normal working range, it is necessary to suppress the instability as much as possible, ideally it should be fully eliminated. When designing a new turbine, it is very important to understand the given problems, which can be supported by both experimental tests and detailed numerical simulations. The article deals with non-stationary CFD calculations of the given issue and compares the results with the data obtained during the measurements in the hydraulic laboratory of the “CKD Blansko Engineering”.



**7 Possibilities of 3D printing when
prototyping pumping
equipment**

UP Olomouc

prof. M. Mašláň
Mgr. H. Kubíčková
doc. L. Bartoněk, Ph.D.
Mgr. T. Ingr

The Selective Laser Melting (SLM) technology was used for 3D-printing of rotors and vanes of pumps. Mechanical and structural properties (metallography, hardness measurement, tensile and bending tests, Mössbauer's spectroscopy) of standard sample bodies were evaluated. Internal and surface defects were monitored by X-ray tomography, scanning electron microscopy. The shape inspection by comparing the CAD model with optical scanning of the final bodies was used to optimize technological parameters.

**8 Reliability and efficiency
improving of energy supply
systems based on functional
surface modification**

**МЭИ Москва
(Moskevský
energetický institut)**

prof. A. Volkov, d.t.v.
A. Ryzhenkov, d.t.v.
A. Parygin, k.t.v.
A. Naumov, k.t.v.

This article is devoted to the new methods of power equipment functional surfaces modifying with the purpose of imparting new properties to them which are developed at NRU "MPEI". Two coating technologies are considered. The first one is used to increase the service life of power equipment. The second is based on the formation of a nanoscale modification of the surface, changing the conditions for its wettability, which makes it possible to improve the efficiency of power equipment.

**9 Measures for Enhancement of
Nuclear Safety in the Czech Republic
after the Fukushima Accident -
Diverse refuelling of the
depressurized I.C, SFSP and the
storage pool GA 201**

**ÚJV Řež a.s.- divize
ENERGOPROJEKT
PRAHA**

Ing. Z. Vlček

The main topic of this paper is the description of technical solutions for application of a diversified way of refilling the refrigerant into the depressurized primary circuit and the spent fuel storage pool based on the adopted NAP for increasing nuclear safety of the nuclear power plants Temelín (ETE) and Dukovany (EDU) "The assessment of safety and safety reserves in the light of the Fukushima nuclear accident". This is a complement to the TB30 system, using the SIGMA pumps of the type 80-NQD-315-11-A7-FE.



10 **Technical cooperation of the
Škoda JS - SIGMA DIZ on the
primary part of completion of
the construction of units 3 and 4
of the NPP Mochovce**

ŠKODA JS a.s.

Ing. O. Peleš

In the paper, the participation of the Company SIGMA DIZ on the completion of the EMO34 (NPP Mochovce, the 3rd and 4th blocks) construction is focused on the core part (the primary circuit). The paper content proceeds from the design and implementation documentation, as well as from the realization of the assembly and installation on the building site. The paper describes the main parts of the delivery of the Company SIGMA DIZ and their functioning within the whole NPP. The paper conclusion is devoted to the detail of the assembly works with focusing on welding works.

11 **Theory and Practice in the
Activities of the Company
HYDROSYSTEM project a.s.**

**HYDROSYSTEM
project a.s.**

Ing. R. Zapletal

The Company HYDROSYSTEM project a.s. has their business activities divided according to the following areas: high-pressure water hydraulics (represented by systems for removing iron scales with water jet, pressure testing systems), optimization of dynamic properties of hydraulic systems and hydraulic transport of slurries (represented by hydraulic transport of ash matters and high-viscous materials).

The motto of the conference "Theory and Practice of Current Pumping Techniques" penetrates all activities of the Company HYDROSYSTEM project a.s. This paper describes how it is concretely reflected in the area of optimization of dynamic characteristics of hydraulic systems.

12 **Overhaul of pumps in order
to save electric power**

**SIGMA GROUP a.s.
divize Energo**

Ing. B. Klíma

Realization of pump overhauls using renovation methods by application of ceramic composites ARC Chesterton on the internal parts of hydraulic compartments in order to save electric energy of the driving electric motor.



13

**Significant projects of
pumping stations in
Egypt**

**SIGMAINVEST
spol. s r.o.**

Ing. I. Klíř

This paper is devoted to some of significant projects of pumping stations equipped with SIGMA pumps, which were implemented in Egypt within the years 2003 - 2018.

14

**Shape optimization and
its use for hydraulic
design of pumps**

**CENTRUM
HYDRAULICKÉHO
VÝZKUMU, spol. s r.o.**

Mgr. T. Krátký
Ing. L. Zavadil, Ph.D.
Ing. J. Stareček
Mgr. J. Kmec
Ing. P. Moravec, Ph.D.

The paper deals with possibilities of using shape optimization for the needs of hydraulic pump design. This is mainly an overview of the main problems associated with automated numerical simulations and the interconnection with theoretical methods of mathematical optimization. The benefits and limitations of shape optimization are shown on factual cases implemented within the SIGMA. The conclusion is then focused on future plans and other directions in development.

15

**Mobile pumping stations
SIGMA**

**SIGMA Výzkumný a
vývojový ústav, s.r.o.**

**CENTRUM
HYDRAULICKÉHO
VÝZKUMU, spol. s r.o.**

VŠB-TÚ Ostrava

Ing. J.Šoukal, CSc.
Ing. O. Ott
Ing. P. Dobeš, Ph.D.
L. Koudelka

The Company SIGMA Výzkumný a vývojový ústav, s.r.o developed a high-capacity mobile pumping station of the MČS SIGMA series. The originally developed low pressure and medium-pressure series of stations in their container workmanship versions are designed for rescue teams for their interventions during floods and deluges. The pumping capacity reaches up to 2 m³ / s at a pressure up to 5 bar.

At present, high-pressure container stations are developed for long-distance transport of large volumes of water for fire fighting and removal consequences of natural disasters. The stations can achieve outputs up to 0.5 m³ / s at pressures up to 20 bar, allowing transport distances up to 2 km with the station standard equipment with delivery hoses, with special equipment it could be significantly more. The paper presents the main types of pumping stations destined for removal consequences of floods and the most powerful high-pressure pumping station being usable for fire and technical interventions.



16	Implementation of emergency pump A-40-P-PCD-5-60-45-250-YC-170 for PP of the VVER 1200 type	SIGMA PUMPY HRANICE, s.r.o. SIGMA GROUP a.s., divize Průmyslová čerpadla	Ing. J. Míčková Ing. P. Sehnoutka Ing. P. Abrahánek Ing. L. Husička
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This article describes the implementation of a high pressure plunger pump for injection of boric acid solution into a pressure compensator in the mode of leakage from the primary circuit to the secondary circuit and for ensuring the subcritical state of the reactor in the event of a failure of control system of protection in nuclear power plants of the VVER type. The solution consisted in the engineering design, selection of suitable materials, sub deliveries and technologies, all supported by the design and control calculations and the corresponding quality management for deliveries to NPPs and the subsequent production, acceptance procedures and delivery of equipment for the 1st and 2nd units of the Novovoronezh NPP in the Russian Federation.

17	Cooling pumps for conventional and nuclear power engineering	SIGMA GROUP a.s., divize Průmyslová čerpadla	Ing. R. Hansgut V. Dlouhý Ing. P. Jorda
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The paper describes the realization of business cases of cooling pumps deliveries by the Company SIGMA GROUP a.s. within the last 5 years for newly built energy blocks of thermal power plants. Furthermore, the development of the cooling pump 2000-BQUW-3440-26.5-OW-000 with impeller vanes control within operation, intended for the NPP Kursk - Russia, blocks VVER-1200 MW is mentioned in this paper. The vertical regulating volute casing pump designed for parameters $Q = 73500 \text{ m}^3 / \text{h}$ and $H = 37.2 \text{ m}$ is the largest and heaviest pump in the Sigma production programme through 150 years of the company history

18	Technical development in Sigma in the past 5 years	SIGMA GROUP a.s. SIGMA Výzkumný a vývojový ústav, s.r.o.	Ing. J. Nevěřil Ing. O. Čepl
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The paper mentions important tasks of technical development of the SIGMY GROUP a.s. in the past 5 years which have had a major impact on the commercial success of the company, and which at the same time determine the main business activities for the near future.





SIGMA GROUP a.s.
Jana Sigmunda 313
Lutín 783 49

info@sigma.cz

www.sigma.cz



Tuzemský obchod

tel.: +420 585 652 145
fax: +420 585 652 051
e-mail: sales@sigma.cz

Zahraniční obchod

tel.: +420 585 652 145
fax: +420 585 652 051
e-mail: export@sigma.cz

Personální oddělení

tel.: +420 585 651 105
fax: +420 585 651 195
e-mail: jobs@sigma.cz

**SIGMA Výzkumný a vývojový
ústav, s.r.o.**

tel.: +420 585 652 402
fax: +420 585 652 400
e-mail: vvu@sigma.cz

**CENTRUM HYDRAULICKÉHO
VÝZKUMU spol. s r.o.**

tel.: +420 585 652 402
fax: +420 585 652 400
e-mail: chv@sigma.cz



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