

Water Jet Workplace

Institute of Geonics of the CAS
Institute of Clean Technologies for Mining and Utilization of Raw Materials
for Energy Use



Contact

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Prototype of a water jet cutting head for medical applications

Specialisation

The Water Jet Workplace at the Institute of Geonics of the CAS has been systematically built since 1985. The important impulse for its development was a project of the Operational Programme Research and Development for Innovations – Institute of Clean Technologies of Mining and Utilization of Energy Raw Materials dealt with in cooperation with the VŠB- Technical University of Ostrava, within the framework of which the equipment of the Workplace was supplemented by new pumps, water jet manipulators and measuring instruments. Research activities of the Workplace concentrate on intensifying the effects of high-speed water jets, on the interaction of water and abrasive jets with

materials and on the development of new areas of utilisation of high-speed water jets in machining, in medical applications and for ultrafine grinding and disintegration of materials.

Competences

The Workplace offers precision cutting by a water and abrasive jet, testing of surface treatments, removal of surface layers, cleaning by pulsating water jets, disintegration of particles by water jets, visualisation, measurement and evaluation of flow, numerical modelling of flow and stress calculations, analysis of the size of particles, measurement of surface characteristics, pressure tests and expert consultations with top experts including the preparation of projects

and proposals for their implementation. To this end, the Workplace is equipped with high-pressure plunger pumps Hammelmann HDP 253 (maximum working pressure 160 MPa, maximum flow rate 67 l/min) and Hammelmann HDP 254 (maximum working pressure 260 MPa, maximum flow rate 40 l/min), PTV75-60 high-pressure pump with two pressure multipliers (working pressure from 40 MPa to 415 MPa, maximum flow rate 7.8 l/min at 415 MPa), AMU-2500 Abrasive Suspension Jet unit, ABB IRB 6640-180/2.55 Master robot for manipulating the cutting head of a water jet, X-Y PTV WJ202-2Z 1xPJ – 2D cutting table with a tilting cutting head, specially designed for water-jet cutting, a system for the visualisation and measurement of flow velocity-

-fields (2x PIV Imager Pro X 2M CCD camera with accessories, NL 135-15 PIV two-pulse laser with accessories and optics for the creation of a light section, high-speed cameras High-SpeedStar 3G CMOS and Phantom v2011 with accessories, control computer with DaVis software), a notebook-based measuring system with a DAQ National Instruments (16-bit) measuring card and LabView Full Development System software, FRT Micro Prof optical profile meter, Keyence VHX 5000 mobile digital microscope with accessories, Fritsch Analysette 22 NanoTec particle size laser analyser and a computing system for flow modelling equipped with CFD ANSYS software.

Target groups

The Workplace offers cooperation both on the basis of joint projects and contract research to domestic and foreign academic and research institutions as well as industrial enterprises and firms engaged in the research, development and utilisation of high-speed water jet technology throughout the spectrum of their applications (cutting, machining, rehabilitation of structures and buildings, cleaning, removal of coatings and deposits, hydrodemolition, mining, abrasive materials, applications in medicine, food industry and other special waterjetting applications, high-pressure technology, safety aspects etc.).

Results

As part of research oriented to intensify the effects of high-speed water jets, an original method of genera-



A kerf created by rotating pulsating high-speed water jet in granite massif (Erlich quarry, locality Žulová)

ting a pulsating fluid jet by means of an acoustic generator, which is patent-protected in the USA, Australia, Czech Republic and by a European patent with validation in 20 states and has been used in the form of an exclusive licence agreement with a renowned German manufacturer of high-pressure equipment – Hammelmann GmbH. The Workplace has also participated, in cooperation with the Military Technical Institute of Armament and Ammunition (MTIAA) Slavičín, in the development of technology of disposal of the solid propellant of SS-23 missiles. Based on the results of laboratory and field tests, a technological procedure has been developed for cutting the charge and creating a fine ground mixture of the charge in water by means of high-speed water jets. The procedure was then applied by the MTIAA when disposing of all the SS-23 missiles that were in the arsenal of the Czech army.

Furthermore, for example, a draft was drawn up of technology of waste-free disposal of explosive charges placed in boreholes for seismic research within the built-up area of the municipality of Halenkovice, based on the use of high-speed water jets for the safe uncovering and subsequent removal or destruction of these explosive charges.

In cooperation with the German partner ANT AG, the Workplace is involved in the development and testing of the unit for generating an Abrasive Suspension Jet.

Years of experience in the field of flow modelling are utilized in the development of a new abrasive cutting head working on a completely different principle in cooperation with the PTV Ltd. in Hostivice, the Czech manufacturer of high-pressure equipment. Techniques for other technological operations performed by water jet technology (such as turning, milling) and for modification of surface properties of materials (peening) were developed and improved.