



<sup>1</sup> Ján KMEC, <sup>2</sup> Ľuba BIČEJOVÁ, <sup>3</sup> Miroslav GOMBÁR, <sup>4</sup> Alena VAGASKÁ, <sup>5</sup> Lýdia SOBOTOVÁ

## WATING ABRASIVE RECYCLACION SYSTEM AFTER HYDROABRASIVE EROSION PROCESS

<sup>1</sup> UNIVERSITY OF PREŠOV IN PREŠOV, FACULTY OF MANAGEMENT, KONŠTANTÍNOVA 16, 080 01 PREŠOV, SLOVAKIA

<sup>2-4</sup> TECHNICAL UNIVERSITY OF KOŠICE, FACULTY OF MANUFACTURING TECHNOLOGIES, ŠTÚROVA 31, 080 01 PREŠOV, SLOVAKIA

<sup>5</sup> TECHNICAL UNIVERSITY OF KOŠICE, FACULTY OF MECHANICAL ENGINEERING, LETNÁ 9, 042 00 KOŠICE, SLOVAKIA

**ABSTRACT:** The global environmental trends lead to utilizing of so called „clean technologies“ with minimum environmental impact. In case of high-speed continual waterjets application it is possible to expect substantial raise of products manufacturing efficiency. The analysis of the system of separating and recycling abrasive material from a fluid in abrasive water jet cutting process was the aim of the research. The research has been conducted with process condition, environmental approaches and high effectiveness of the technology.

**KEYWORDS:** abrasive water jet, recycling, abrasive material

### INTRODUCTION

Technological process concerned with water jet cutting and the next waste elimination or waste treatment, in a view of high environmental demands, represents increasing demanding system for energy reducing, too. It is necessary to analyse environmental aspects of technological jetting process with abrasive material after cutting and the next recycling. There is a close connection between using abrasive materials in JET technology and abrasive material recycling regarding to waste elimination. In the case if, the abrasive material is stored on scrape heap, the additional expenses are required.

There is an environmentally harmful material mixed with mineral oil and with undefinable chemical composition. If it uses the recycling process in the actual application area, then there is no problem with the process security and the efficiency can be higher and the determination of optimal conditions reducing the manufacturing cost [1]. The direct processing of production waste into re-usable material is a big advantage.

### WATERJET WASTE TECHNOLOGY

The environmental approach is a very important problem after water jet cutting connected with water and abrasive material. Environmental resources are limited, too. In the process two types of waste are produced:

- waste water,
- slime, sludge.

There is waste water, usually intend after drafting from working and for a further cleaning, technical modifying and using. The slim is the second important compound and consists of the abrasive grain particles and the microscopic machining particles.

The normal technology enables to separate these used abrasive particles from substrate for several economic using. There are several types of abrasive material [1]. Up-to-date used:

- garnet (typical MESH 80),
- olivine,
- corundum,
- silicon sand and others.

Good abrasive performance is more important than the cost of abrasive, since any disadvantage in higher abrasive purchase cost can be outweighed by the higher cutting speed achieved with a better performing abrasive. Therefore cost of abrasive should be weighed against its performance and the most cost-effective abrasive should be selected [2], [3].

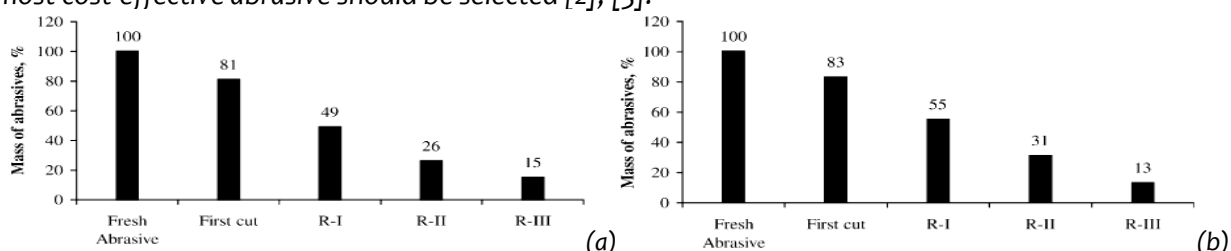


Fig. 1. Recycling capacity of local garnet abrasives with (a) test sample and (b) mesh size 80 with more than 90  $\mu\text{m}$  particles: FA- Fresh abrasives, RI- Recycle I, RII- Recycle II, RIII- Recycle III [4]

The abrasive particle shape is defined by granular rough, roundness and by the size which is tested by sieving.

Abrasive particles disintegrate during the acceleration and focusing processes and also after cutting. During the cutting process, the breakdown of abrasive particles occurs in two stages [5]:

1. particle/particle, particle/water jet and particle/wall collisions in the mixing chamber/focusing tube assembly,
2. particle/particle and particle target collisions.

With proper cleaning and sorting, an important portion of sludge may be recycled and fed back to the cutting process. [1], [5], [7].

#### DESCRIPTION OF ABRASIVE MATERIAL RECYCLING

In the world exist more types of separating and recycling methods depends on technology [1]:

- magnetic separation,
- floating,
- setting of used abrasive material,
- recycling under water flow.

#### POSSIBILITIES OF ABRASIVE RECYCLING UNDER WATER FLOW

The main principle of separation and recycling process is very simple. Depending on the economic conditions we can use [1], [6]:

- automatic system WARD,
- mechanical system WATING.

**Automatic system WARD** – is system for transferring and recycling of abrasive material. Ward is industrial step forward in regarding to water jet process. The function of WARD consists of:

- removing of slime (sediment) from the tank,
- separating used abrasive from other waste,
- washing and drying bigger abrasive,
- in final phase again sift through sieves.

In the Fig.2, Fig.3, Fig.4, and Fig.5 are shown the examples of automatic system WARD.



Fig. 2. Recycling mechanism WARD



Fig. 3. Cleaning of abrasive material



Fig. 4. Drying of abrasive in dryer



Fig.5. Returning of sifted abrasive

**Mechanical system WATING** – the entire development system is based on the patented technology, which during the first separation phases the effluent, is discharging (launched) from the table battle. In the next phase the abrasive material is picked out on the metal palettes and can pass to following washing process. In sedimentation process in the first part the maximum of 94 % of used abrasive grains are separated and only 4 % can be caught. Of course in the second sedimentation part about 2 % and in the third part it is not important for optimal performance because there is only water with slime. [1], [5].

The Fig. 6 gives descriptions of washing using water and contaminated particles, which accumulate during mixture and separate from impurities.

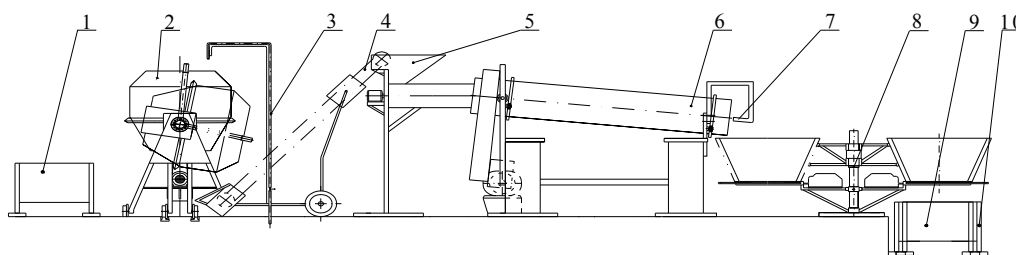


Fig. 6. Mechanism for abrasive recycling – WATING

1-palette with used abrasive, 2- washing device, 3- water supply, 4- conveyor belt, 5- feeder device, 6- drying device, 7-torch holder, 8- oscillating sieve, 9-pallet with sorted out abrasive, 10- pallet with waste

In experiments, different materials for the recycling were used. Optimal results were achieved and by WATING technology of recycling abrasive material could be used as the new one in the next process [1].

The possibilities of using these recycled materials were performed on the WATING solution. The optimum of regeneration is 53 % of whole grains.

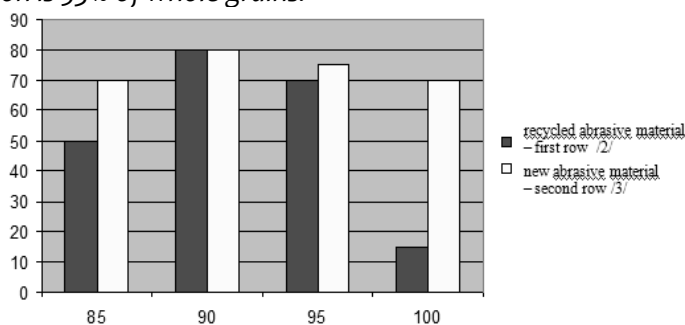


Fig. 7. Relation between grain dimensions and grind density

The clearness of reused abrasive also influenced on the roughness of worked material. The dependence of the roughness on the cutting speed for material AISI 304 with thickness 8 mm (material of abrasive-garnet, mesh 80) is shown in the Fig.8.

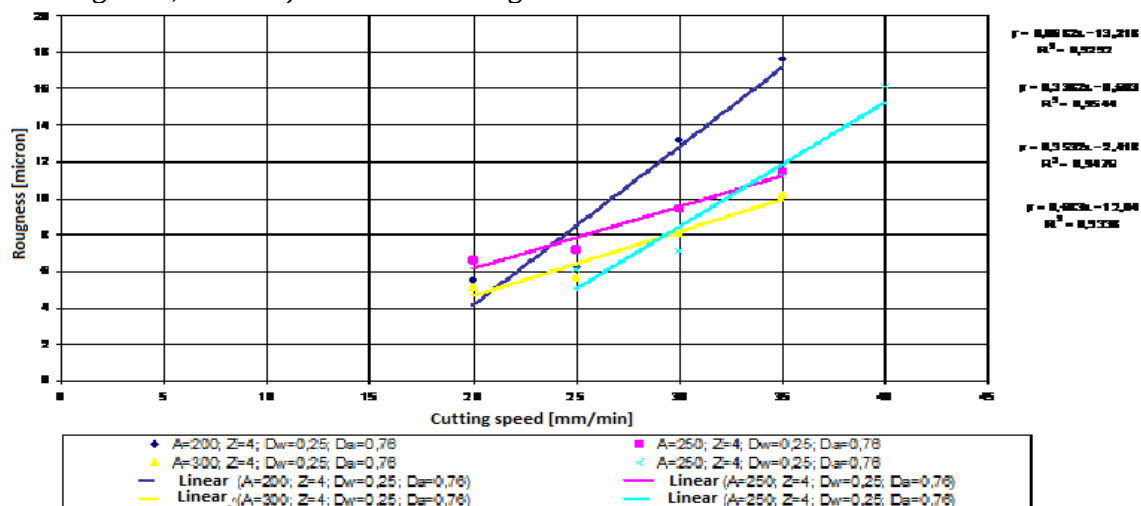


Fig. 8. Relation of roughness to cutting speed for AISI 304, thickness 30 mm, at various abrasive weight values

### CONCLUSIONS

The device system for cutting technology of firm WATING, s.r.o. Presov, and solution of a separating and recycling of abrasive material from fluid is being described.

We suppose that the reasons for recycling are not only environmental, but also mechanical because of other suitable usage of the abrasive material.

It is apparent that grain sharp is more suitable for mixture tank and also helps to prolong serviceable life about 20 %.

The new abrasive particles dimension reach maximum of GARNET 80 and in the abrasive material after cutting process maximum of GARNET 95.

When considering recycled material there is 53 % of regeneration from the first phase and more then 53 % could be used also in the second phase. The regeneration process should be reproducible.

The WATING results are summarised as follows and confirmed with the world research. The most important properties of recycled abrasives are [1], [5]:

- Particle size of abrasive and its distribution,
- Fragmentation is more pronounced in the mixing chamber and focussing nozzle than after cutting and it is higher with fresh abrasives than recycled abrasives.
- Recycling if continued beyond three cycles, discontinuous cutting will result due to blockage of the flow channel with finer abrasive particles.
- Depth of cut with abrasive,
- Improved surface finish is obtained with test sample than mesh size 80
- The reusability of abrasives can be approximately 80% reused after the first, 50% after the second cut, 25-30% after the third cut, and 15% after the fourth cut.

#### ACKNOWLEDGEMENTS

The authors express their sincere thanks to Slovak Ministry of Education, Science, Research, project VEGA No. 1/0396/11 and KEGA-12-006-00.

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