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ENVIRONMENTAL ANALYSIS OF AWJ SYSTEM USED FOR CUTTING USING RECYCLED ABRASIVE

ENVIRONMENTAL ANALYSIS OF AWJ SYSTEM USED FOR CUTTING USING RECYCLED ABRASIVE MATERIAL

Monika Karková, Ján Kmec¹

Autori pôsobia na katedre strojírenství, Vysokej školy technickej a ekonomickej v Českých Budějovicích. Vo svojom výskume sa venujú problematike vodného lúča z oblasti technológie a taktiež v oblasti environmentálnej.

The authors work at the Department of Mechanical Engineering, the The Institute of Technology and Business in České Budějovice. In their research they deal with the issue of the water jet technology in the field of technology as well as in the environmental field.

Abstract

The analysis of the system of separating and recycling abrasive material from a fluid in abrasive water jet cutting was the aim of the research. The research has been conducted with process condition, enviromental approaches and high efectivenes of the technology.

Key words: effluent, abrasive material, recycling technology, catcher tank

Abstrakt

Analýza systému oddeľovania a recyklácie brúsneho materiálu z tekutiny pri rezaní abrazívnym vodným lúčom bola cieľom výskumu. Výskum bol vykonaný s podmienkami procesu, environmentálnymi prístupmi a vysokou efektívnosťou technológie.

Kľúčové slová: odpadová voda, abrazívny materiál, technológia recyklácie, zachytávacia nádrž

Introduction

Technological process concerned with waterjet cutting and the next waste elimination or waste treatment, in a view of high enviromental demands, represents increasing demandings system for energy reducement,too.

It is necessary to analysis enviromental 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 because of waste

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elimination. In the case, 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 we use 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

A very important problem after waterjet cutting is environmental approaches connected with water and abrasive material. Environmental services are limited, too. In the process two types of waste are produced:

- waste water
- slime

There is a waste water, usually intended after drafting from working and for a further cleaning, technical modifying and using. The slime 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 uses. There are several types of abrasive material. [2] Up-to-date used:

- granet / Fe₃ Al / SiO₄ /3/ typical MESH 80
- olivin
- corundum
- silicon sand

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

Description of abrasive material recycling

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

- mechanical system WATING
- automatic system WARD

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. In the next phase the abrasive material is picked out on the metal pallets and can pass to following washing process.

In sedimentation process in the first part the maximum of 94 % of used abrasive grains is 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]

Experimental WATING evaluation

The process of recycling abrasive material used in abrasive jet cutting incudes :

- washing device
- conveyor belt / belt transport /
- feeder
- drying device / dreth /
- vibration sieve

Figure 1 describes washing using water and contaminating particles which accumulate during mixture and separate from impurities.

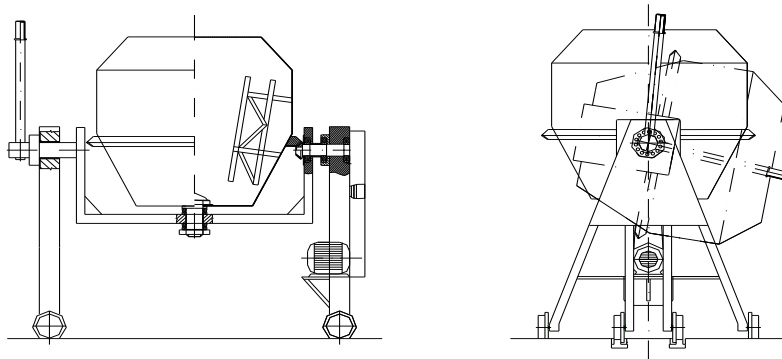


Figure 1. Washing device

It is possible to transport the abrasive material automaticaly on a special belt / see fig. 2 / especially when the abrasive material is cleaned.

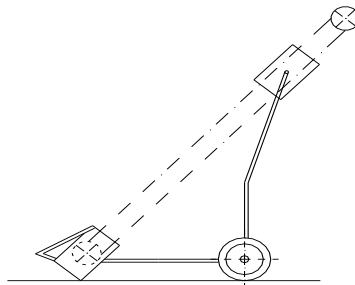


Figure 2. Conveyor belt

The clean substrate is transported to feeder device / see fig. 3 /.

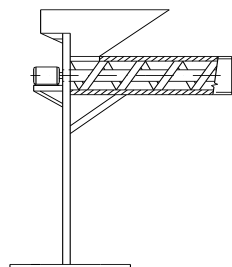


Figure 3. Feeder device

Following operation, the abrasive material accumulates in a tangle-drier / dryers / tank / see fig.4 /

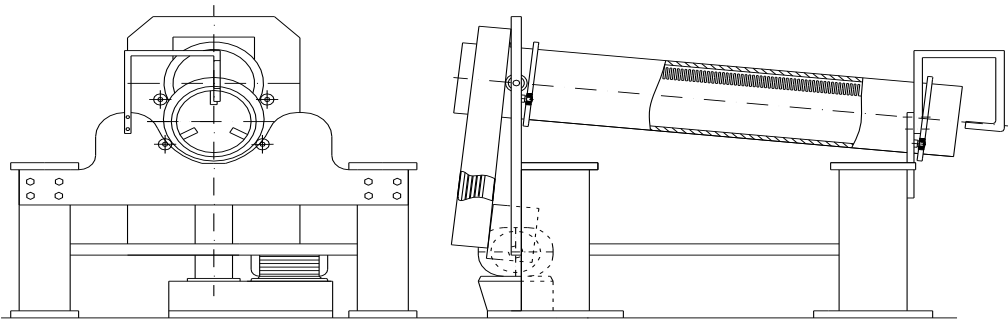


Figure 4. Drying device

Thus it is apparent, that it would be drying provided by gas flame on cylinder jet direction. By the help of flame spinning the moisture water consumption is minimized in abrasive material. This step is important although the performance amount is evident only 0,5–1,0 per minutes.

The water is disposed as passive system and abrasive is not centrifugally separates from the fluid.

For the purpose of to be the demanded abrasive particles sizes, the abrasive oscillating sieve is described in fig.5.

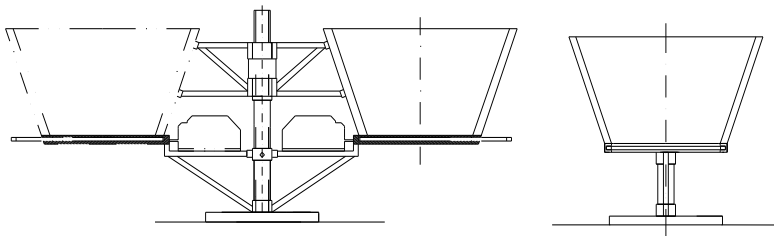


Figure 5. Oscillating sieve

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 material were performed on the WATING solution. The optimum of regeneration is 53 % of whole grains.

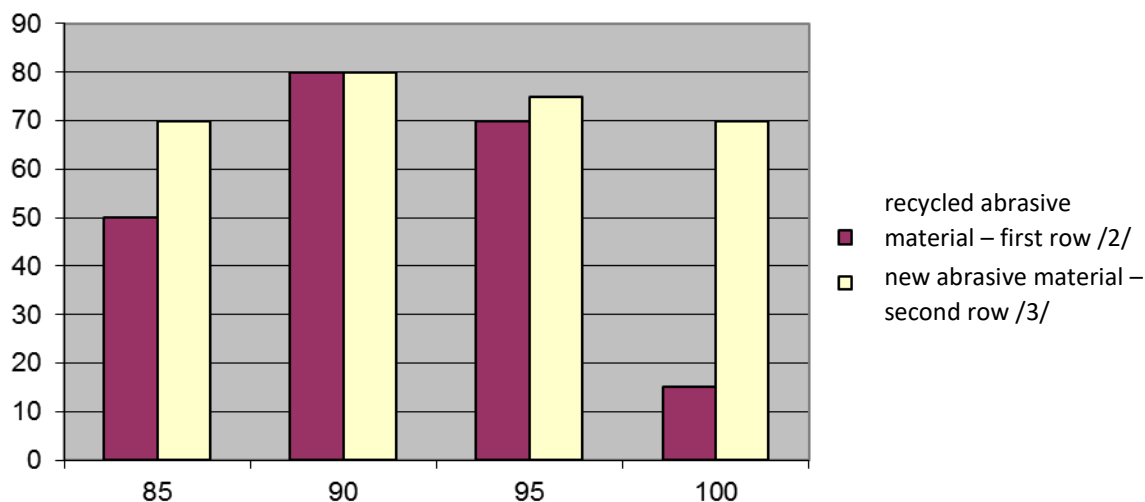


Figure 6. Relation between grain dimensions and grind density

Conclusion

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

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

It is apparent that grain shap is more suitable for mixture tank and also help 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.

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