



International Conference on Manufacturing Engineering and Materials, ICMEM 2016,  
6-10 June 2016, Nový Smokovec, Slovakia

## Monitoring of acoustic emission during the disintegration of rock

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### Abstract

Many factors and complexities are involved in breaking rock with conventional methods. Water jet technique is an effective solution to the problems faced in the conventional method. Rock deterioration is the most important step in the mining, civil, mineral engineering, the technology of water jet cutting and disintegration of various material attained continuous growth during the last decades. Water jet is widely used in industrial application such as disintegration of materials and rock, cleaning and removal of surface layers. The literature is reviewed the particular attention to the detection, recording and monitoring of fracture evolution, monitoring of collision healing and creep in rock and other material using acoustic emission. Acoustic emission has been widely used in industries and other various field such as steam pipes and pressure vessels, composites materials, monitor the welding and corrosion progress ,metals and also applied numerous structural components. It is a technique to direct monitor defects formation and failure in structural materials. However, it can also provide information on the stress field, fatigue and the fracture pattern behaviour.

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Peer-review under responsibility of the organizing committee of ICMEM 2016

*Keywords:* Acoustic emission, Rock Disintegration, Waterjet

### 1. Introduction

In the past two decades, the use of natural stone has been made more significant. The growing commercial market and competition for natural stone have resulted in increased demand for innovative manufacturing process. Due to the composition of natural stone (granite, shale, concrete) especially granite machining and processing with traditional system have some difficulties. Therefore new technology comes in the picture that is abrasive water jet machining. Due to this increase machining efficiency by minimizing production time and cost required. Among the innovative manufacturing process water jet have developed broad application[1],[2]. This technology (WJ) is a new innovative tool for cutting rocks and rocklike materials. It can be used for cutting, pre-weakening and drilling of rocks .The technology is a promising tool not only for manufacturing industries but also for the other industries including civil and mining engineering fields due to its distinctive features of precise shape cutting, a good surface finish, smaller kerf widths, extended tool life, complex free-form cutting, process automation, no dust, better working conditions, and environment [4],[3],[5],[10],[11].

#### Nomenclature

WJ	Water Jet
AWJ	Abrasive Water Jet
AE	Acoustic Emission
FFT	Fast Fourier Transform

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AERMS Acoustic Emission Root Mean Square
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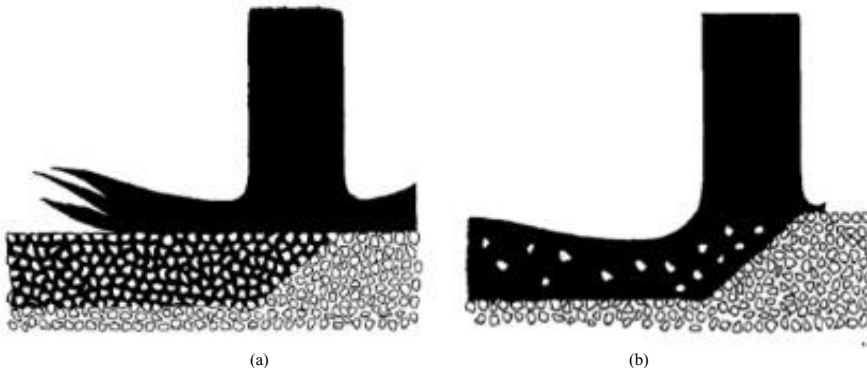
These features make the technology an environmentally friendly technique over other traditional cutting processes such as circular sawing in natural stone machining and processing applications. The effective parameters on the rock cutting or erosion performance is important due to its unique characteristics and attractive properties such as, high durability and resistance to scratches, cracks, stains, spills, heat, cold, and moisture, granite has been widely used as dimensional stone in public and commercial applications in today's life.[4]

The cutting device working with high pressure jet, called water cutter or water jet is currently being used for cutting of various types of hard material. New technology is continually being developed and limitations are being challenged as a matter of routine. A continuous water jet can be modified to Abrasive or Pulsating water jets[2]. This is also happening in the field of high-pulsating water jets. In the recent years, there are so many applications where it is more useful and economical than standard (conventional) machining processes. This technology is excellent for the cutting of complex shapes, and in fragile materials such as ferrous and nonferrous material, concrete, and rock [5],[6], as well as with the addition of abrasive agents to the water jet. Whatever industrial need, Water jet is an accurate, flexible, and efficient cutting system.

A continuous water jet is the basic type, in which modified form is abrasive and pulsating water jet. Both technologies are widely used in cutting of natural stone in with different areas. Presently water jet is usually adopted water cutter. Further research has also been conducted worldwide using pulsed water jets to investigate the effect of operational parameters such as: nozzle diameter, standoff distance, pulse frequency and jet pressure on rock breakability. When the working pressure is above 200 Mpa that is the problem is nozzle wear. Due to which the device has the limitation of poor interaction and is hard to process the graphics. Therefore it is difficult to users to operate. So that, the application of water jet is limited [3]. The method and inspection of surface quality by continuous control(online) still remain the issue[6],[22],[23],[24],[25],[26],[27],[28],[29]. In accordance with the performed measurements we are searching for the dependence between acoustic emission and its factors of the WJ factor. Acoustic emission has been widely used in industries and other various field such as steam pipes and pressure vessels, composites materials, monitor the welding and corrosion progress, metals and also applied numerous structural components. It is a technique to direct monitor defects formation and failure in structural materials. However it can be provide information on the stress field, fatigue and the fracture pattern behavior. AE can be divided into two main groups first is traditional acoustic emission and second is source wave form analysis. Preliminary research demonstrate that the problem of acoustic emission is noise reduction, reliability, and difficulty in solving the inverse problem of the wave propagation in source function and wave form analysis. AE detects the activities inside the material that only needs one or more small sensors on the surface of the structure, in contrast to this non-destructive evaluation (NDE) examine the internal structure of the whole material.

## 2. Mechanism for disintegrating the rock

The basic phenomena that occurs during the breakage of the rock is that when the water jet strikes the surface it starts penetrating into the pores between the grains. As the jet traverse over the surface the penetration stops at that point when the jet has left the point has left the striking point. This penetration takes place during the time of exposure  $T=d/v$ , where  $d$  and  $v$  are the diameter and transverse velocity at the jet respectively. This concept leads to two approaches: (a) when the stagnation pressure of the jet  $p_0$  is less than the threshold pressure of the rock  $p_{th}$  the jet does not cause any damage to the rock (b) when the stagnation pressure of the jet is greater than the threshold pressure of the rock the grains are spelled at a rate equal to the mean rate of the water that passes through the grain. [10],[11]. To estimate the velocity at the water primates the pour with the help of Darcy's law through porous media. dynamic viscosity of the water and pressure of the water pores, modified permeability of different rocks also plays vital role during disintegration of rocks.



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