AUTOMATED DESCALING – IMPROVING SAFETY AND EFFICIENCY

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Abstract

The application of high and ultra high pressure water jetting systems in the Alumina Mining and Refining process has been steadily increasing over the years. Concurrently, there has also been a progressive increase in the pressures and flows applied giving rise a need to re-assess the safety and efficiency of operations. With this in mind WOMA (Australia) has invested significant efforts into the development and manufacture of hydraulically operated remotely controlled machines. To date various purpose built machines have been supplied by WOMA to customers. These machines have not only provided for increased operational capabilities and efficiencies, but also, and by no means less importantly, improved safety of the operational process to a completely different level. An operator can be in full control of the process, while located dozens of metres away from the jetting nozzles and, if necessary, behind a protective shield. In this scenario, the operator can override automatics and take control over the hydro blasting process if and/or when needed. Importantly, this does not compromise safety as the visual information is communicated via a monitor, located closely to the operator.

Based on the experience gained, WOMA is currently engaged in the development of new generation of these machines, which could in practice completely eliminate human involvement in the hydro blasting process. Apart from the obvious improvements in safety, an automatically operated machine would set a new standard in efficiency.

1. Introduction

The environmental concerns appeared quite high on the agenda by the end of the 20th century and, if anything, this trend still continues its momentum at the beginning of the second decade of 21st century. The application of high and ultra-high pressure water jetting systems in the technological processes allows to not only significant reducing an impact on the environment, but it also brings noticeable advantages into the various operations – whether they are on surface, underground, within a confine space or underwater.

The modern industrial water jetting systems are capable to deliver a flow of a few hundred litters per minute at a pressure exceeding 1,500 Bar (150 MPa). These are extremely powerful machines, resulting in significant recoil forces, which require sophisticated methods of control providing for efficiency and safety of operation.

2. Controlling devices – early stages of development

The water jetting systems had a relatively narrow range of applications in the not too distant past.

These applications were dictated by a couple of factors, such as:

- Ownership of the machines.
  Majority of the machines had been owned by either individual operators or small companies, providing services to the larger organizations. Therefore, the machines had to be highly mobile and relatively inexpensive. Thus, they were of somewhat smaller size and lower power;
- Tasks, the machines were assigned to perform.

The water jetting systems had yet to prove their capabilities to the larger organizations, which could afford to invest in new technology and equipment. In turn, the controlling devices from the past were required only to assist an operator with handling jetting equipment, while it was essential for the devices to be conveniently transportable, easily dismountable and reinstalled as necessary. Incorporation of a simple control system was uncommon, mainly reserved for the prolonged recurring activities, where it was a justifiable convenience, rather than a safety and efficiency driven necessity.

3. Contemporary control systems

The water jetting systems have, in time, proven their capabilities. This was a key turning point, resulting in serious interest from the large organisations within the resources industry. The interest was met by the leading water pump manufactures around the world, offering much more powerful equipment. Consequently, the owners and operators of this equipment realized a need to re-assess the safety of operations without compromising its efficiency. As a recognized leader in the water jetting systems and their operations, during last decade WOMA (Australia) has invested significant efforts into the development and manufacture of control systems. Depending on specific requirements, these systems could be allocated into three different groups:

- **Group 1**: relatively simple, not remotely controlled, hydraulically, pneumatically or electrically driven devices. They are represented by a fixed, either stand alone or connected to a main pressure/power supply servo device, which could be operated at the same location as a jetting nozzle, or within close proximity to the nozzle;
- **Group 2:** remotely controlled, hydraulically or pneumatically driven devices. They are represented by a fixed, either stand alone or connected to a main pressure supply servo device, which could be operated from a reasonable distance (tens of meters) from a jetting nozzle;
- **Group 3**: remotely controlled, hydraulically driven devices. They are represented by a self propelled, stand alone servo device, which could be operated from a significant distance (within line of sight) from a jetting nozzle.

As could be seen, there a few major differences between the mentioned groups. They are as follows:

- whether a device is remotely controlled or not;
- whether a device is stand alone or connected to a main pressure supply;
- whether a device is fixed or self propelled.

Naturally, the most complex, from designing and manufacturing points of view, is the device, which is remotely controlled, stand alone and self propelled. In fact, it is a quite sophisticated machine, creation of which requires expertise in many engineering domains.

To date various purpose built machines have been supplied by WOMA to many customers.

One of these machines (the Hydromatic) is presented on the photographs below.

Figure 1

Figure 2

The Hydromatic is remotely controlled, self propelled, stand alone machine, which has the following main features:

- an extendable, fully articulated boom;
- automatically, on the move, levelled platform;
- an independently operated, fully articulated nozzle holder.

However, even such a sophisticated machine has its limitation. From WOMA's point of view, the major limitation is a necessity for an operator to be present or have the machine within a line of sight, while it is operating. Identification of this downside has encouraged WOMA to invest into the development of new equipment, which could be controlled by an operator from virtually any location or work fully automatically.

4. Future control systems

WOMA carried out a design review of the existing machines and their control systems. The review highlighted a number of common shortcomings, which present the opportunities to improve safety of operation and increase efficiency of the water jetting process.

In particular, an attention was drawn, among the others, to the following points:

Physical presence of an operator within a line of sight, while water jetting is in progress

The presence requires addressing various safety issues, e.g. noise control, flying debris, etc. These issues would be exacerbated, if water jetting takes place within a confine space.

Poor visibility of the treated area, while water jetting is in progress

The visibility could be improved by an installation of an appropriate video system with a remotely located monitor. However, there is another solution for resolving the issue and providing much higher operational efficiency – it is a fully automated mode of operation.

In reality, most practical applications would require a combination of a manually controlled and a fully automated, yet adjustable modes of operation. This combination is necessitated by a variety of tasks a water jetting machine could perform.

A machine needs to undertake a range of movements in order to complete any task. The movements might be, in fact, of some sort of a standard pattern (e.g. rectangular, angular, circular), when the defining linear dimensions could be easily pre-programmed and modified as necessary.

While the automated mode would provide for an efficient application of the water jetting on the standard objects (e.g. tanks, flat surfaces, pipes), the manual mode would be reserved either for the objects of complex shape, or the 'final touch" applications.

5. Conclusions

The remotely controlled fully automated machines would not only provide for increased operational capabilities and efficiencies, but also, and by no means less importantly, improve safety of the operational process to a completely different level. An operator can be in full control of the process, while located dozens of metres away from the jetting nozzles. In this scenario, the operator can override automatics and take control over the water jetting process, if and/or when needed. Importantly, this improves safety as the visual information is communicated via a monitor, located closely to the operator.