CLEAN PLANT

How automated hosing can significantly reduce process water consumption

When utilizing a stream of water to move or dislodge material, a significant reduction in total water consumption can be achieved by understanding and applying the following basic engineering principles: Energy, Frequency and Technique.

Energy

Apart from the phenomenon of buoyancy (making a particle float), water alone has no ability to make an object or material move.

The addition of a pump however enables the conversion of electrical energy into kinetic energy (projectile) in the form of a water stream (mass x velocity), which does have the ability to move, dislodge or fragment a material.

As seen in the equation for kinetic energy below, the amount of kinetic energy that can be generated is affected to a greater extent by the velocity of the water stream rather than by the volume of the water employed.

$$Kinetric\ energy = \frac{mass\ x\ velocity^2}{2}$$

The same amount of material (volume of work) can be moved with significantly less water if the velocity of the water stream is higher.

Due to the phenomime of hose whip, the maximum pump energy that can be employed safely by an operator is limited.

The rate of energy transfer that can be delivered by automated hosing is far greater than that which can be achieved with manual hosing, thus enabling a greater utilisation of available pump power to achieve the same result.

The following table shows a hypothetical comparison between two industrial process water pumps of different power ratings.

			To create 1MJ of kinetic energy	
Description	Pump rating	Water Flow Rate	Time required	Water required
Small industrial pump	12 Kw	200L/min	100 seconds	16,600 litres
Larger industrial pump	100 Kw	200L/min	10 seconds	2,000 litres
			Change in water consumption:	**88 % reduction**

*Pump sizes are hypothetical for illustrative purposes only. Utilization of the available pump energy capacity is dependent upon the system design. All water systems are unique and should only be designed by a trained and experienced professional.

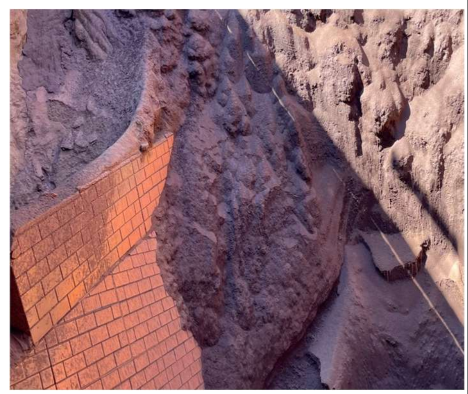
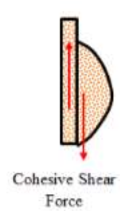
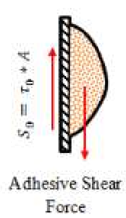
Frequency

With the application of pressure and time, bulk material will consolidate. Further, its internal shear strength increases as does the amount of energy required to break the consolidated material apart.

Furthermore, the additive nature of build-up over time will form geometries that further increase the build-up structure's strength (arches) as it propagates.

This increase in strength over time requires a proportional increase in the amount of kinetic energy (from the water stream) that is required to overcome the increasing internal shear strength of the material.

Frequent short bursts of energy can dislodge build up at the shear zone between the parent liner and the material leading to a reduction in total water consumption when compared to removing build up by erosion.

Time between cleaning events:	(Relatively longer time between cleaning)	(relatively short time between cleaning)
Buildup:	High cohesive strength 	Low cohesive strength 
Shear type & removal method:	Cohesive (erosion)	Adhesive (dislodgment)
Shear diagram:	Material  Material	Liners  Material
Hypothetical cleaning time:	30 minutes (200 L/min)	2 minutes (200 L/min)
Water required:	12,000 liters	400 liters
Cleaning frequency:	Weekly	Daily
Annual water consumption:	312,000 litres	146,000 litres
	Water consumption:	**53%** less water consumed

Myths

It is true that the moisture content of an iron ore product directly affects the material handling characteristics of that product.

To put this into perspective, a iron ore fines product may be characterized by a moisture content of 10%. This is equivalent to 24,000 litres of water over a 24 hour period for a typical conveyor rated at 10,000 tons per hour (240kt per day operation).

Automated cleaning applies short bursts of water with high kinetic energy during ore breaks. It does not apply water to the product itself, and therefore does not directly affect the moisture content of the ore.

Due to the inclination of the receiving conveyor, it is typical that cleaning water will escape the system at the various transfer points where it then makes its way to the nearest plant sump.

Automated hosing enables disciplined process control over the duration, frequency & timing of cleaning events providing improved control over product quality when compared to manual hosing techniques.

Water run off at a transfer point

Summary

Through optimization of process water pump sizing to maximize available kinetic energy in combination with optimization of cleaning frequency automated hosing systems offer a science based approach to minimize annual plant water consumption.

When setup correctly automated systems can deliver short, optimized bursts of kinetic energy during conveyor ore breaks providing both highly effective management of build up that minimizes water consumption whilst also mitigating the water addition to the product.