

Wet-Mix Shotcrete — with the Flexibility of Dry Mix

By Walter Betschart

Have you ever thought to yourself, “Is there a way to shoot wet-mix shotcrete in a more flexible way and with less cleanup?” There is one.

Wet-mix shotcrete, as per common knowledge, requires rather large pumps with pistons or worms. Concrete is mechanically pushed to the nozzle as a dense stream. At the nozzle, air and accelerator (if required) are added to project and compact the material to the substrate.

Worm pump machines can deliver concrete with maximum aggregate sizes of 0.15 in. (4 mm) and are typically used for repair and surface finishing projects. The output is typically up to 5 yd³/h (4 m³/h).

Double-piston pump-based machines also supply a dense stream of concrete to the nozzle and can be virtually pulse-free when shooting. This type of machine can produce high outputs from 5 to 33 yd³/h (4 to 25 m³/h), being particularly suitable for large tunnel construction or where substantial structural volumes are required.

A third possibility, not well known in North America, is wet-mix shotcreting with rotor machines. Rotor chamber pumps of Aliva®, which are commonly known for their use with the dry process, have been further developed over the years to also shoot wet-mix concrete. They are being successfully used for wet shotcrete application in mining and civil construction throughout Europe, as well as many other parts of the world.

Aliva rotor machines, basically the same as in the dry process with the help of compressed air, blows wet concrete from the pump to the nozzle where the accelerator (if necessary) can be injected. The capacity of this type of equipment ranges between 0.90 to 25 yd³/h (0.7 to 19 m³/h), depending on the size of the equipment and the volume of the rotor installed. They are capable of delivering concrete to the substrate at a regular rate and almost free from pulsation.

Shooting wet-mix concrete with rotor pumps does have advantages that simply cannot be dismissed:

- Whenever you have a job where you know there will be many stops and interruptions, with a rotor machine there will be no compli-

cations. As concrete is blown to the nozzle, simply let the hopper go empty and the compressed air in the hoses and pipes will do the rest. There is no concrete loss when stopping the machine. The machine itself can quickly be washed down with a hose. No high-pressure water jet is needed.

- As mentioned before, Aliva rotor machines offer a great range of output capacity. A well-chosen machine type and size and its accessories will enable you to do anything from small concrete repairs up to slope or tunnel stabilization with the same equipment. This comes in handy in confined and narrow areas such as wastewater and water tunnels.
- Midsize rotor pumps with capacities from 1 to 13 yd³/h (0.75 to 10 m³/h) are very compact and fit on the bed of almost any truck. With weights between 1400 and 2600 lb (640 and 1200 kg), these machines are easier to handle than large piston pumps.
- Small and midsize rotor chamber pumps are also available with an air-driven motor. This eliminates the need for electricity and offers a good solution at places such as carbon mines, where no sparks are wanted.
- Steel and synthetic fibers can also be processed, as well as aggregate up to 0.5 in. (13 mm) with a small rotor and 0.75 in. (19 mm) with a big rotor.
- If needed, there will always be the possibility to change from wet to dry concrete without making any changes on the machine. Merely replacing a small piece at the gun gives you that flexibility at a very low cost.

Aliva rotor concrete spraying machines are perfectly compatible with mechanical manipulators such as AL-302.1 telescopic spraying arms or AL-101 Quick Connect spraying heads that can be attached to a wide range of excavators or backhoe loaders of any brand. With the help of manipulators, you will be able to reach a high output and thus fully take advantage of the potential of Aliva rotor pumps.

Hoses for shotcrete with rotor pumps are generally much easier to handle. As the concrete is blown through the hose instead of being pumped, this eliminates the heavy concrete mass in the

hose. Furthermore, rotor pump hoses do not have to withstand more than 1200 psi (8 MPa); therefore, their design does not need to be as tough as the hoses for piston-pumped concrete. This makes rotor pump hoses less rigid, lighter, and above all, a lot cheaper.

The technology behind a rotor machine is not as sophisticated as with a pump. Maintenance and operation are very easy; one worker can service the equipment in less than half a day. For the actual shotcreting, as few as two operators per team can manage the feeding of the machine and the shotcrete placement.

With the relatively small dimensions of the equipment, they can be mounted on many carrier

vehicles. Together with a spraying arm, you can build your own spraying system without having to invest a lot of money.

Rotor pumps in general are less prone to problems when the concrete is not continuously good quality—that is, oversized or mixture of the aggregates. As long as the concrete is not too sticky (fine grain not more than 5%), a rotor machine will be able to convey it. Generally, there is no problem if the slump is lower than typically used for shooting with piston pumps. Also, there is no need to keep pipes or hoses lubricated; thus, no line lubricant chemicals are needed.

To pump concrete with a piston pump, a higher content of cement is often used for the lubrication



Fig. 1: Practicing slope stabilization with wet concrete in Arequipa, Perú, with an Aliva-257



Fig. 2: Slope stabilization with Aliva-257 in Quito, Ecuador. One of the new roads leading to the new airport



Fig. 3: Stabilizing rocks with wet concrete with Aliva-257. Here, the new Converto manual spraying gun is used

The following are samples of projects where rotor pumps were successfully used:

Metro de São Paulo, Brazil – Extension of Line 2, Lot 3

Shotcrete application: Ipiranga Station
Approximate Volume: 10,000 yd³ (7600 m³)
Equipment used: 2 Aliva 262, 1 Aliva 263
Contractor: Construtora Norberto Odebrecht

DAEE – Underpass Castelo Branco Freeway, Brazil

Shotcrete application: 1000 ft (300 m) tunnel with 16.5 ft (5 m) diameter
Approximate Volume: 2000 yd³ (1500 m³)
Equipment used: 1 Aliva 263
Contractor: DP Barros & Viatic

Currently there are many more projects in construction with the use of rotor pumps. The decision was taken to work this way precisely because of their robustness, flexibility, and simple operation.

of the pipes and hoses, resulting in more cement in the mixture than is needed for structural strength. The quantity of the fines, especially the cement, can also be reduced. Rotor machines work well in a wide range of material up to plain aggregates without any additional lubrication with fines.

Rotor machines are very durable, long-lasting pieces of equipment. It is not unusual to find 30-year-old equipment still in perfect working condition. As you can see, there are many arguments to start thinking about using rotor pumps for your next shotcrete job.

Two good examples for a successful use are construction and extension projects in Brazil. As the conditions of the jobsite were not always very favorable, the subcontractor Albau Construtora Ltda. decided to do the job with rotor machines instead of pumps. The main reasons for this deci-

sion were the constantly changing quality of the concrete, repetitive interruptions of the supply of the concrete due to traffic, and bad organization at the jobsite. The decision to use a rotor machine was more than justified as Albau Construtora Ltda. had the possibility to suspend the shooting without major losses and less organizational hassles.



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