

## **Pre-packaged Materials – Providing Quality, Convenience and Flexibility**

*By: Joe Hutter*

During the depression years of the 1930's, a Cincinnati-based ready-mix producer recognized that a growing number of people were requesting a bucket or shovelful of "drippings" from returning ready mix trucks. The reason; they had a small job to complete around the house and simply didn't need the minimum 1 or 2 cubic yards of concrete. Recognizing a good business opportunity, the entrepreneur developed a process that combined dried aggregates and Portland cement in a package, with a moisture barrier to form a single easy to use unit.

Today, millions of bags of pre-packaged concrete, shotcrete, grout, and mortar are produced at production facilities around the world and shipped to jobsites on remote islands, in deep underground mines and on more typical jobsites everywhere. The most compelling reasons for choosing to have shotcrete provided in a pre-packaged form are quality, convenience and flexibility. With the availability of quality packaging plants across North America, contractors no longer have to be concerned with the task of proportioning and mixing shotcrete components on jobsites. The blending can and should be done accurately and under controlled conditions where components are accurately weight batched; aggregates are dried, eliminating varying moisture contents, and thorough blending ensures mix consistency from batch to batch.

In addition to the expected ratio of cement and blended aggregates, many of today's shotcrete mixes may also contain very small amounts of multiple admixtures such as accelerators, air entraining agents, corrosion inhibitors, or superplasticizers (for wet-mix shotcrete). Steel and synthetic fibres are also used to enhance certain hardened properties and silica fume is used to reduce permeability and provide the shotcrete with improved shooting characteristics. Dosage of these components must meet extremely precise tolerances and blending must be done in a manner that ensures thorough distribution of all mix components.

Most quality mixing plants are equipped with counter current, high shear mixers that have the ability to efficiently handle both fine and coarse shotcrete blends. The high shear action of these types of mixers will allow even and thorough distribution of components of varying dosages and varying bulk densities (for example Portland cement (94 lbs/ft<sup>3</sup>) and silica fume (25 lbs/ft<sup>3</sup>). With this type of control of the shotcrete mix, especially when compared with site mixing, one of the biggest "quality variables" is eliminated.

Arguably, one of the most difficult variables to control is the consistency of the aggregate supply. The desired particle size distribution must be maintained through a blend of fine and coarse aggregates. In the case of site mixed shotcrete, bulk, stockpiled sand and gravel will often be subject to segregation and variations in moisture content when left exposed to the elements. An improper aggregate blend with too little coarse aggregate will affect compaction and result in poorly consolidated shotcrete. An aggregate blend

with increased fines will result increased water demand, compromising the benefits of good quality shotcrete (low shrinkage, low permeability, high strengths etc.).

The quality offered by pre-packaged shotcrete materials ensures that the proficiency of the nozzelmen, and the efficient operation of the equipment are the only variables preventing a quality shotcrete application. Steps to improve the proficiency of nozzelmen have been introduced through the development of an ACI nozzelmen training and certification program. This program has been accepted by shotcrete contractors and specifying authorities across North America and gives them the confidence that specific nozzelmen have the capabilities and talent to properly apply shotcrete. Shotcrete test panels or mock up panels should also be used however, to replicate the shotcrete application and orientation. Pre-packaged materials can further facilitate this operation by ensuring the same shotcrete mix is used to shoot mock ups or test panels as is used on the job.

The convenience of pre-packaged materials cannot be argued as is evident from the growing number of shotcrete contractors who, when given the choice, have chosen to use pre-packaged shotcrete mixes on their projects. Excess (unused) material can be returned to the contractor's warehouse reducing job clean up. Movement of materials on the jobsite is much easier when pallets of product can be dropped in multiple locations. In cold climates, pre-packaged products when properly stored will not freeze, eliminating the need to heat sand and stone piles. Bulk tote bags can be suspended over the hopper of the shotcrete machine, eliminating the need to have an individual continuously feeding the machine. And most importantly, the contractor, consulting engineer and owner all have the "peace of mind" knowing that the components in each bag conform to the specified mix design.

Over the years, changes in packaging methods have provided the shotcrete contractor with added flexibility on the jobsite. Although the majority of pre-packaged shotcrete mixes are still supplied in 50 lb (23 kg) paper bags, manufacturers have expanded packaging options to include bags that can hold a cubic yard of shotcrete and greater. These bags can facilitate the transportation of large quantities of shotcrete to areas that are difficult to access such as underground mines, tunnels, islands and remote or isolated locations.

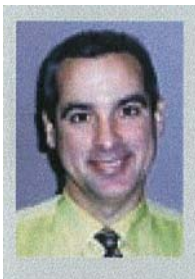
Hardrock mines in northern Ontario often rely on shotcrete for small construction projects, for support in large, permanent, underground installations or as a primary ground support in development areas. This shotcrete, supplied in 1 metric tonne (2,205 lb) reusable bulk tote bags, provides shotcrete crews with large volumes of high quality mixes while working more than 7,000 ft (2200 m) below ground.

The development of moisture resistant packaging has further improved the ability of manufacturers to deliver shotcrete to further, more remote destinations. Working with their shotcrete supplier, Falconbridge Limited of Toronto, has developed a system of shotcrete delivery for their Raglan Property, located in northern Quebec, approximately 50 miles (80 km) south of the Arctic Circle. Shotcrete is packaged in 1360 kg (3,000 lb)

specially designed bulk bags that have been fitted with plastic liners to prevent moisture from prematurely hydrating the shotcrete mix. The shotcrete material can be stored outside, where it is often buried in snow before it is “dug out” and transported by ramp underground. This unique mix, which has been designed to perform in below freezing temperatures, is then applied to the frozen rock surface by Raglan shotcrete crews.

By contrast, the same shotcrete supplier has used similar packaging methods to ship shotcrete mixes to warmer climates in the Caribbean. Sea freight containers are filled with bulk tote bags and similar packaging is used to prevent water from coming in contact with the shotcrete mix during the voyage from North America to the islands of the Caribbean. The pre-blended mix is stored on site, sometimes for several months, before being used by shotcrete crews and despite rain and high humidity, instances of hydrated chunks in the bags are almost unheard of.

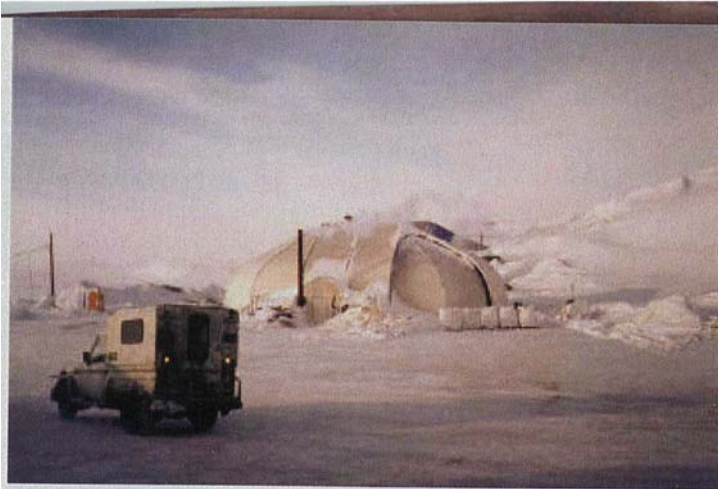
Despite the perception that site mixed materials are cheaper, contractors around the world are turning to pre-packaged shotcrete to ensure that their materials are properly proportioned. These contractors have weighed the risk of using inexperienced labour to properly proportion the shotcrete mix for their experienced shotcrete crews. Pre-packaged shotcrete mixes will provide the contractor, specifier and owner with the same consistent quality mix design from the start of a shotcrete project until its completion. Whether your project is across the ocean or around the block, the convenience and flexibility of pre-packaged shotcrete materials make it a logical choice!



**Joe Hutter** is Vice President, Sales, for King Packaged Materials Co. He has more than 20 years of experience in the cement/shotcrete industry. He has been an active member of ASA and has chaired the ASA Marketing Committee since its inception.



*Shipment of prepackaged Shotcrete in 2205 lb (1 metric tonne) bags  
To an underground mine*



*Shotcrete storage area at Falconbridge Raglan property*

