dmg Glass GROUP

November/December 2005

Vol. 28 No. 6

Glass INTERNATIONAL

Connecting the International Glassmaking Market

MAGNUM™ SERIES

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Available with same sizes as ProE MAGNUM™

VX EVO MAGNUM™

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Guaranteed delivery times and secured quality

ProE MAGNUM™

EXPANDING THE BOUNDARIES

Where others see the limit we see the possibility.

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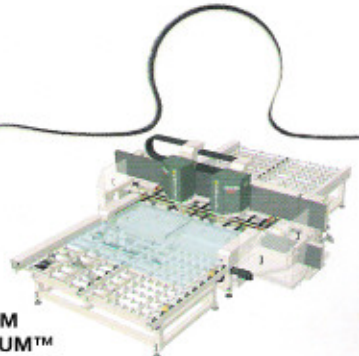
Multi-functional all-in-one system: Drilling, milling, countersinking. Over 30 different tools on board

Possible to integrate together with VX EVO MAGNUM™ and ProE MAGNUM™



HDM MAGNUM™

Back to batch for pharmaceutical glassmaker

Pharmaceutical glass manufacturer Kimble Glass blends 120 batches a day of abrasive ingredients, using rotary mixers to make this possible.

▶ *Raw materials are discharged from the scales above and flow through the diverter gate (centre, rear) into either mixer No. 1 or No. 2. The pipe in the foreground is not integral to the mixing operation, but is used only if material has to be transferred from one storage bin to another.*

The manufacture of high-quality pharmaceutical glass is an exacting business that calls for careful control at all stages of the process in order to obtain the desired properties in the final product. Those properties vary, depending on what the glass is to be used for, so the initial step — the precise measurement and thorough mixing of multiple ingredients — is critical to the rest of the operation.

For example, Kimble Glass of New Jersey blends more than 120 batches/day of raw materials, using three basic recipes that include virgin sand, cullet and a number of other ingredients, some of which are present in quantities of 1% or less. Each batch is subsequently melted and formed into tubing that ranges from 2mm to 180mm diameter. Kimble uses the tubing to fabricate products such as syringes, vials and ampules for medications and laboratory equipment such as graduated cylinders, beakers and petri dishes.

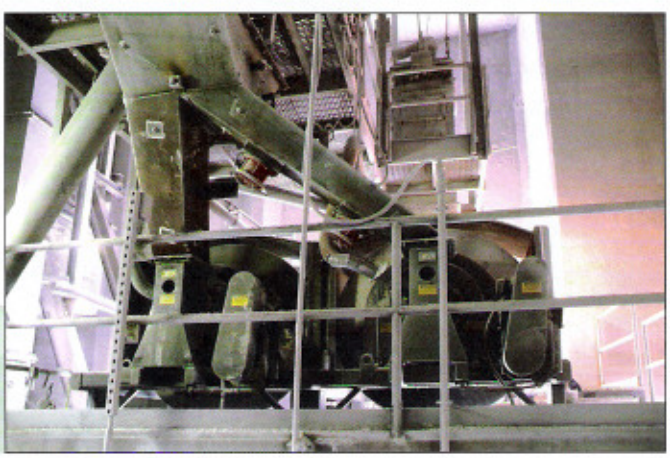
Rotary mixers

Kimble's plant, which is more than 100 years old, was given the go-ahead in May 2002 to install new mixing equipment and went on stream with two GB-35 rotary mixers made by Munson Machinery Company - the same company that made the old rotary machine installed as used equipment in 1961 in the plant. Each of the GB-35 (for glass batcher) mixers cost $53,000 and has a theoretical volume of 100 cubic feet. The working capacity of rotary mixers of this size is typically 1.42 cubic metres, but they are rated at 0.99 cubic metres for glass batching to minimise contact between the highly abrasive glass and the machines' seals.

"We bought two small mixers to have flexibility, so that if one goes down we could still keep operating," says John Schwab, senior furnace engineer at the plant. "This is important for us because we don't have the capacity to store more than eight hours of mixed batch material." In the unlikely event that both machines were to break down, the backup is the old 1.7 cubic metre Munson mixer.

The main reason for buying the Munson mixers was to minimise downtime. "Our contacts at Munson say they can supply parts off the shelf for any mixer they've made since 1940, but in our experience nothing breaks on these machines," Mr Schwab says.

"We didn't look for increasing efficiency because we felt we already had an efficient operation and efficient mixing and we didn't want to lose anything by switching to another type of mixer. Many people recommended pan mixers, but we make three recipes every day, and if we used a pan mixer we would have to pull it apart and vacuum it out every time we changed the recipe." In contrast, the rotary mixers can be purged in 3 – 4 minutes.



▶ *This view of the feed system from the scales to the mixers shows the fill end of each mixer, with mixer No. 1 on the left and No. 2 on the right. Only one mixer is used at a time.*

GB-35

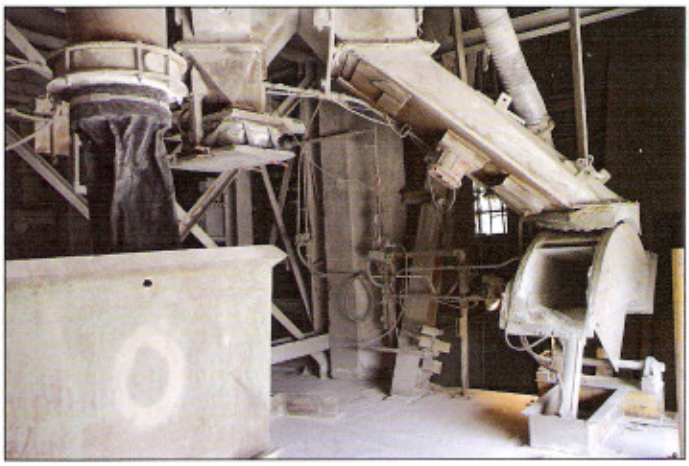
The GB-35 consists of a horizontal, rotating drum that has a stationary inlet at one end and a stationary outlet with a discharge gate at the other. The mixing vessel is supported by two oversized trunion rings, which ride on heavy-duty alloy roller assemblies. Material is charged through the inlet chute while the drum is rotating. Mixing flights or vanes tumble the batch materials in a multi-directional manner, while simultaneously moving the material toward the outlet.

Munson says the mixing action produces a 'fluidised zone' with random dynamics that results in uniform mixing without segregation. At the same time, the mixer is a gentle blender that will not degrade the size or shape of particles. When the blend is complete, the discharge gate pivots into the machine and directs the material down a discharge spout.

Batch recipes

Kimble's three batch recipes consist of a hard borosilicate glass and two neutral borosilicates, one of which is a flint (clear) material and the other amber-coloured. The hard borosilicate is of alpha 33 expansion, designed for use with corrosive chemicals and reusable laboratory equipment. The neutrals are alpha 51 expansion and are used for medical applications.

Virgin sand is typically the main ingredient, ranging up to 80% of a recipe, followed by cullet, whose content varies from 20% to as much as 70%. The cullet is mostly recycled from Kimble's operations and some is purchased. It is crushed to a maximum particle size of about 19mm diameter, which is a suitable size for melting, then dried to reduce the moisture content to 1% or less.



◀ Mixed batches are discharged from a mixer via the discharge chute on the right. In the left foreground is a dust collector, and behind it, to the right, is a discharge port for purged material.

▼ A view of the mixer discharge gate. A pneumatic cylinder forces the stopper-like gate inward, into the mixer, allowing the batch of mixed material to discharge into a can.

Other ingredients include a few percent each of nepheline or nephelite (a silicate of sodium), 5-mol borax and boric acid, and about 1% each of barium carbonate, sodium chloride and potassium carbonate. For amber glass, Kimble uses trace quantities of rutile and iron oxide, which are weighed by hand before being added to a batch. "It only takes 0.2% of those materials to get the amber colour," says Mr Schwab.

Blending and mixing

Thorough dispersion of the materials is crucial, so Kimble ran trials at its onsite laboratory to establish mixing times for the new machines. The upshot is that the mixing time for a 1497kg batch is 2 minutes and 15 seconds and complete dispersion is achieved to create a complete, homogeneous mix.

Kimble blends batches of two weights - 1497kg and 1134kg - which are dictated by the arrangement of the equipment in the furnace house. "Our batch house is remote from the furnaces, so we discharge each batch into a can of 1497kg and 1134kg and transport the cans to the furnaces on a monorail," Mr Schwab explains. "We don't have day bins and we don't mix mass quantities, because when borax gets warm and the humidity is high it hardens. This is a problem with long-term storage of raw materials, so we mix them as we need them and don't store anything for more than 24 hours."

The cans are approximately 1829mm tall by 1067mm or 1219mm diameter, with a truncated cone and a swivel plate for discharge on the bottom. In the furnace house, each can is manually dumped into hoppers above screw chargers that feed the furnace. The building configuration doesn't lend itself to automation.

Kimble runs two shifts and has a daily production of about 74 1497kg cans and 54 1134kg cans, for a total of about 1.18 million kg/wk. Raw materials are stored in silos and gravity-fed onto scales under computer control, in accordance with the recipe. On high-volume items such as sand, feeding is controlled by a gate and a jogger. Smaller-volume materials are fed to the scale by a rigid auger. "We have a major scale and a minor scale," says Mr Schwab. "Anything above 91kg goes on the major scale."

A typical recipe run consists of 18–20 cans. Each batch is mixed in 2 minutes 15 seconds and takes 45 seconds to discharge the batch into a can, for a total of about 3 minutes. "As soon as a batch starts mixing we start weighing the next batch so that we're ready to load it as soon as the mixer is emptied," says Mr Schwab. Purging is necessary only when there is a recipe change.

The initial step – the precise measurement and thorough mixing of multiple ingredients – is critical to the rest of the operation.

◀ Recycled cullet includes material rejected from the manufacturing process, such as rejected clear (flint) tubing.

Construction

The GB-35 mixers are constructed of abrasion-resistant materials suitable for this demanding application. There are also wear liners in places that are subject to the greatest abrasion, such as the feed spout and the discharge cone. Even so, Kimble replaced the liner at the inlet with a special steel alloy that has a Rockwell hardness rating of 80. "We wouldn't need this if we didn't use a lot of cullet," says Mr Schwab. "But cullet is very abrasive - much more so than sand. Also, there is a freefall of about 20ft from the point where materials are discharged from the scale to the point where they enter the mixer, so the cullet has a lot of velocity."

The bulk density of the glass batch is about 1600kg per cubic metre. For a 1497kg batch, this equates to 0.92 cubic metres - within the mixer's rated capacity of 0.98 cubic metres. "We limit the batch size to keep abrasive material away from the seals, which are probably the parts that are the most likely to wear," he says. "We have been resealing about every 3–4 months as preventive maintenance.' It takes about 90 minutes to change the seals, which are made of ceramic fibre.

"We have been running these machines for three years," says Mr Schwab, "So far we have had no problems and there is no sign of significant wear."

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