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Mixing eHandbook

Avoid Mixing Mix-ups

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Table of Contents

Product Release


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Solid - Liquid Mixing Experts
You have the application
>> We have the solution!
NEW!
NEW!
CMX 2000
MHD 2000
SLT 2000

Ad Index

Wet Grinder Withstands Abrasive Materials

Handles large lumps at high flow capacities for heavy duty applications

THE MODEL 10 x 6 Megagrinder reportedly satisfies requirements for a more efficient wet grinder that can handle lumps as large as 4 in. (10 cm) at flow capacities upwards of 500 gpm (100 m^3ph). Designed and built with six rows of heavy-duty heat-treated 17-4 PH teeth that mesh with the three rows of teeth on the unique three-prong helical impeller at a tooth/tooth tolerance of 0.030 in. (0.78 mm), the grinder rips, shreds, hammers and disintegrates grindable materials until they are small enough to exit through the small openings in the discharge grid plates. The surrounding volute allows for the pumping flow to exit through the discharge grid holes and then be pumped against as high as 80 ft of head.

Using hardened materials for the impeller and stationary teeth on the pump chamber liner enables the grinder to withstand the abrasive nature of chemical slurries. An oil-lubricated ductile iron cast and machined bearing housing with heavy-duty support designed to meet requirements of the pulp and paper industry, backs up the heavy-duty grinding chamber. Heavy-duty cartridge type double mechanical seals, along with oil-bearing isolators suit offshore oil drilling applications.

The Megagrinder has a 10-in. inlet and a 6-in. diameter outlet. Power requirements vary from as low as 25 hp at 950 rpm to 125 hp at 1,200 and 1,800 rpm. Electric motors are specified based on the requirements of the specific industry group.

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Bematek
In-Line Wet Mixers & Mills

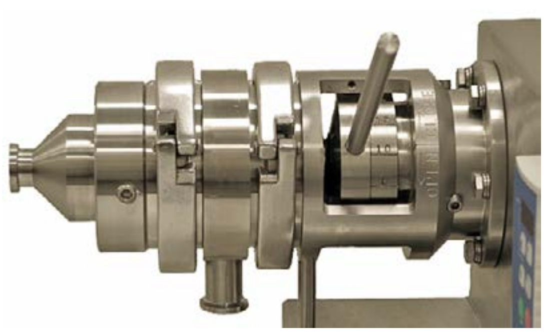
Bematek's New Benchtop Laboratory Colloid Mill

The wet milling community has long dreamed of a true benchtop colloid mill that produces scalable results. Previous efforts to solve this difficult engineering task have resulted in bulky and heavy colloid mills that produced non-scalable results. At long last, Bematek has stepped forward to fill this need with its new and innovative **Model CBT-50-PB** laboratory colloid mill.

The Model CBT-50-PB is an accurately scaled-down version of the highly regarded Bematek production size colloid mills that fits comfortably on a standard-size laboratory bench and operates from standard laboratory electrical outlets. The truly innovative design retains all of the outstanding features that have set the Bematek production size colloid mill apart from its competition. This unique colloid mill, with its minimal hold-up volume milling chamber consisting of just a few components, provides precise scale-up of laboratory results to Bematek's production size colloid mills, making the CBT-50-PB and related models an ideal R&D tool for the development of new products. These same features also make the CBT-50-PB well suited for small-volume production applications.

To enhance the versatility of the CBT-50-PB colloid mills, Bematek offers a wide range of inlet/outlet accessories. These include various inlet/outlet adapters to allow connection of the colloid mill to other laboratory equipment, such as feed pumps. Also, small-volume feed hoppers and all of the required fittings and valves to configure a self-contained processing system are readily available from Bematek.

The CBT-50-PB measures only 26 x 13 x 14 inches and weighs just 75 pounds with a 1 hp motor and a built-in VFD motor speed controller. The milling chamber is fitted with either ¾" or 1" industry-standard quick clamp I/O fittings, and it has a hold-up volume of **less than 50 ml**. The conical rotor/stator set has a gap that is adjustable from 0.001 to 0.090 inches while the mill is in operation, and the rotor speed is typically **5000 fpm** at 60Hz. The motor and the milling head are connected via an ultra-smooth and quiet v-belt drive, and the VFD motor speed controller is operated with a panel-mounted user keypad.



The many standard options for the CBT-50-PB make it easy to configure the mill perfectly for the intended application. Bematek's experienced application engineers can help you select the optimum construction materials, rotor/stator type, inlet/outlet accessories, motor size (up to 3 hp) and motor speed controller (internal or remote mounted). Because of its *Modular Engineered Design*, these various options are easily installed in just a matter of minutes without any special tools.

For more information: visit www.Bematek.com, call 978-744-5816 or e-mail Bematek@Bematek.com

Consider More Than Static Mixers

A number of technologies can handle pipeline mixing

THE TERM "pipeline mixing" covers mixing of materials in a flowing line downstream of a junction. The mixing may involve miscible liquids, immiscible liquids and multi-phase mixtures. Options include just letting materials mingle naturally, using pipe fittings to spur contact, and installing static mixers, spray nozzles or spargers. Static mixers now dominate pipeline mixing — but that doesn't mean they're always the best choice.

Let's consider a recent case that involved choosing a better pipeline mixer for a liquid/liquid service that included mixing both miscible and immiscible liquids.

This application has two mixing steps: 1) mixing two miscible liquid reactants; and 2) adding the reactants to an immiscible liquid catalyst. Some reactions take place at the interface. Others occur inside the catalyst phase after the reactants dissolve into the catalyst. The catalyst-to-reactants ratio is roughly 1:1 by volume; the catalyst has the same volume as the total reactants in the system. Neither the reactant phase nor the catalyst phase is well defined as either a continuous phase or a discontinuous phase.

The idea was to improve yields by more-thorough reactant/reactant and reactants/catalyst mixing. This would increase inter-phase surface area, which would help both types of reaction mechanisms. The current setup relies on a simple pipe junction upstream of the reactors. We evaluated a spray nozzle, a sparger and a static mixer as a possible replacement.

Conventional spray nozzles accelerate a liquid to create a jet. The liquid then breaks up into smaller droplets. The major types of spray nozzles that might be used here are based on (1) rotating flow in a chamber that exits 90° from the liquid inlet, (2) swirl imparted by an internal vane or (3) a narrow stream cut by a spiral blade (pig tail).

These nozzles form droplets primarily through a combination of liquid ligament breakup and slicing of liquid sheets leaving the nozzle. Both mechanisms vary with liquid velocity, surface tension between phases and other physical properties. Jet instability is a key factor in making lots of drops. The little data available show most mixing velocity is shed within 12 in. to 18 in. of the nozzle. No significant droplet formation occurs because the original liquid ligaments or sheets don't form.

A sparger is a pipe with multiple holes that create a pressure drop forcing flow to distribute across the holes. (This pressure drop only is imposed on the liquid being injected, not the entire stream.) With the sparger installed into the main line, the injected flow of one stream would enter the second stream. The sparger could be aligned either across a larger pipe (at 90°) or along the same flow line as the larger pipe.

As with a spray nozzle, enhanced liquid mixing comes from local turbulence created by injecting a high velocity liquid into a second liquid. The mixing is likely at least as good as that of a spray nozzle. Design and installation of a liquid sparger typically is both cheaper and simpler.

Static mixers have become dominant for good reason. They use vanes or blades as elements. This enables mixing to occur at relatively low pressure drop, as little as 10% or 20% that of a sparger. The only potential downsides are that a static mixer often requires a longer straight pipe run for installation and pressure drop is applied to the entire stream.

Overall, the sparger and the static mixer are the best technical choices. Both have proven track records. In contrast, the spray nozzle, which is designed for liquid injection into gas, rarely is used in liquid/liquid services and should be avoided.

Despite this, the plant has opted for spray-nozzle injection for both mixing tasks. It considered spray nozzles proven technology because they have been used in this process by other plants. Here, though, hydraulic constraints limit the pressure drop to a fraction of that at other units; so results may not be as good.

Not agreeing with a decision doesn't free an engineer of the responsibility to help the site derive the most benefit possible from its choice. So, we recommended use of pig-tail-type nozzles. These mechanically "cut" a solid liquid stream into sheets but don't form as uniform droplets as the other types in conventional services. However, their mechanical design is guaranteed to at least do something. The cutting action will improve liquid/liquid mixing somewhat. Also, the cutting edge acts as a minor mixing element in its own right.

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Improve Hydrogenation Reactions

Enhancements in mixing technology allow greater conversion rates and thus better space/time yields

By Werner Himmelsbach, EKATO RMT

NUMEROUS GAS/LIQUID reactions, which are often used to synthesize specialty chemicals, take place under mass transfer limited conditions. Improvements in mixing technology allow greater conversion rates and thus better space/time yields, and usually with better product quality as well. Such reactors and agitator systems will now be described using the hydrogenation process as an example. The corresponding insights also apply to many other reactions with technically relevant gases.

Hydrogenations are frequently encountered reactions in the chemical and pharmaceutical industries. As the name implies, they use hydrogen as a reaction partner. Examples include:

- Reduction of nitro compounds to amines.
- Conversion of multiple carbon bonds to single bonds.
- Reduction of carbonyls and nitriles to alcohols and amines.

These reactions are generally carried out as heterogeneously catalyzed processes. Commonly used catalysts are palladium on activated carbon (alternatively platinum, rhodium, ruthenium or cobalt) and Raney nickel. The process conditions vary over a very wide range, depending on the specific reaction. The typical pressure range lies between a slight positive pressure of 1–2 bar and up to more than 100 bar, the temperatures range from 30–350°C. Reaction enthalpies can be very high. These operating conditions and the handling of hydrogen and catalysts, some of which are self-igniting in air, present demanding requirements for the reactor system and particularly for the mechanical seal. The mixing system has the task of suspending the catalyst, intensifying gas/liquid mass transfer, recirculating unconsumed hydrogen and removing the heat evolved during the reaction. In continuously operated systems there is an additional task of ensuring fast contact between the educt stream and the hydrogen-loaded catalyst.

SEQUENCE REACTION

The mechanism of a heterogeneously catalyzed gas/liquid reaction follows always the same scheme. The actual chemical reaction takes place on the porous surface of the catalyst. But before this can happen, the following transport steps must take place (Figure 1):

- Transfer of hydrogen from the gas phase into the liquid phase. The volumetric mass flux of hydrogen is:

$$\dot{m} = k_L \cdot a \cdot (c^* - c)$$

If the reaction is sufficiently fast, this step can be decisively influenced by the dispersion system, particularly by the specific interfacial area.

- Convective transport of the educts to the catalyst.

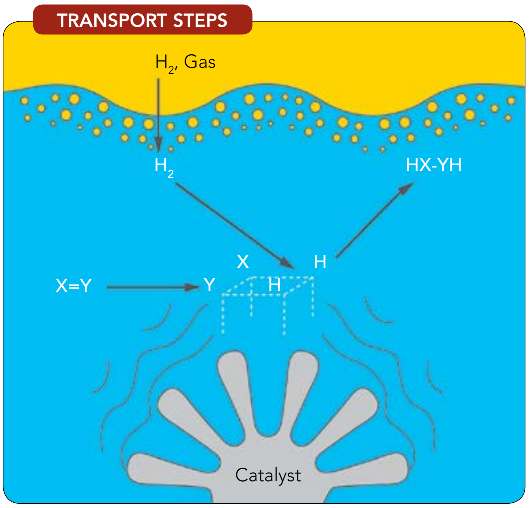

Figure 1. A simplified transport mechanism is used for catalytic hydrogenation.

- Diffusion of the educts through the boundary layer to the catalyst.
- Diffusion of the educts into the pores of the catalyst.
- Chemisorption or physisorption of the educts onto the surface of the catalyst.
- Surface reactions, e.g. following the Langmuir-Hinshelwood or Eley-Rideal mechanisms.
- Desorption of the products (accelerated by the heat released by very exothermic reactions).
- Diffusion of the products out of the catalyst pores.
- Diffusion of the products through the boundary layer.
- Convective transport of the products.

The reaction rates of slow reactions are governed by the reaction kinetics of the respective material and catalyst systems, which cannot be influenced by mixing technology in most cases. Fast reactions, like the aforementioned reduction of nitro-compounds, are usually limited by mass transfer from the gas phase into the liquid phase. A fast reaction sequence is thus not only desirable in order to maximize the space/time yields: insufficient mass transfer and the associated depletion of hydrogen at the surface of the catalyst can also lead to undesirable side reactions with a low selectivity. Therefore, the agitator/reactor system must provide the maximum power for the transfer of mass and heat.

HYDROGENATION IN MIXING VESSELS

Mixing vessels are the most cost-effective and simplest reactor design that can also be easily adapted to different reaction conditions in multi-purpose equipment. However, the simplest version with external half-pipe coils has only limited cooling capacity, which limits its application range to slow reactions with a small reaction enthalpy. More demanding requirements can be fulfilled with the modified mixing vessel described below.

Different types of gassing systems for such reactors are shown in Figure 2. These include:

- Feed of hydrogen into the head-space, aspiration via surface eddies and the vortex: this method is inefficient owing to the ever smaller surface/volume ratio in larger vessels and is thus only sufficient in very slow reactions.
- Feed of hydrogen into the head-space, aspiration and dispersing via a self-aspirating impeller, e.g.

the Ekato Gasjet. The gas flow rate can be varied with the impeller speed. The system is easy to operate and higher mass transfer rates are possible.

- Feed of hydrogen beneath a gassing impeller (e.g. Ekato Phasejet). High mass transfer rates are possible. To prevent the feed of fresh gas being affected by pressure building up in the reactor, unreacted hydrogen must be recirculated from the headspace via an external pipe and a fan. This solution, however, is unsatisfactory from the production engineering point of view.
- Feed of hydrogen beneath a primary gassing impeller (Phasejet) and recirculation of unre acted hydrogen using a self-aspirating Gasjet. Process management of this combination is simple. This provides the highest mass transfer rates among the different industrially available gas/liquid contact equipment.

LOOP REACTOR ASPECTS

In a loop reactor, the hydrogen is sucked into the circulating reaction mixture through an injector. Heat is removed via an external heat exchanger. This reactor provides the following operating characteristics:

- Delayed removal of heat via the external heat exchanger may lead to local overheating and thus to a lower selectivity.
- After efficient mass transfer in the jet, hydrogen depletes during the relatively long recirculation period (byproducts, inactivation of the catalyst).
- Large spatial requirements, complicated constructive measures to compensate thermal

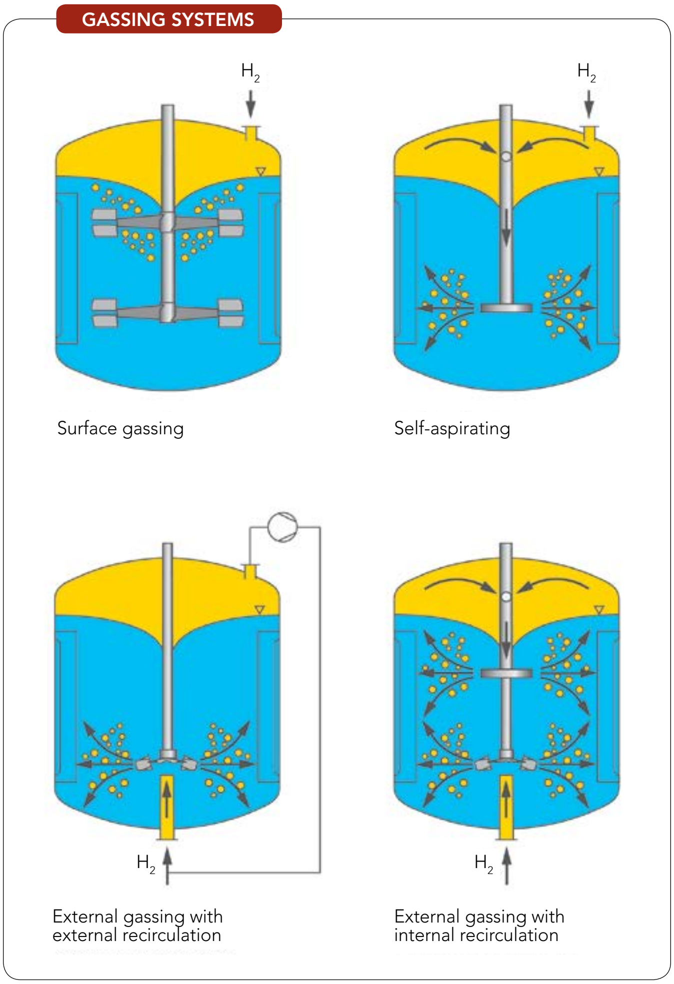

Figure 2. There are many different types of gassing in agitated reactors.

expansion between the reactor and the heat exchanger.
- The pump requires a shaft seal for catalyst-containing products.

HIGH PERFORMANCE GASSING REACTOR

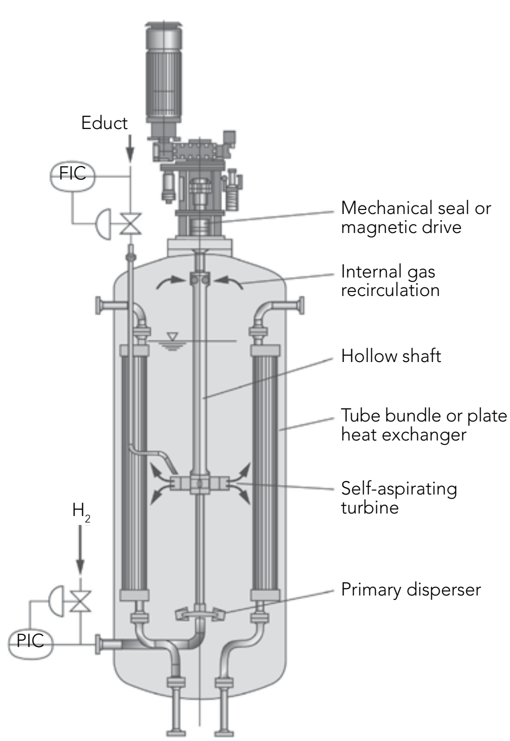

Figure 3. The reactor provides an efficient combination of external gassing with internal gassing circulation.

COMPACT HIGH PERFORMANCE GAS/LIQUID REACTOR

Figure 3 shows the aforementioned efficient combination of external gassing with internal gas recirculation in a compact high performance reactor. The necessary heat removal — the second limiting factor in fast and extremely exothermic hydrogenation reactions — is achieved with an internal tube bundle or a plate heat exchanger.

Fluids can flow unhindered through tube bundle heat exchangers, in particular. They represent a good compromise between the achievable internal heat transfer surface area, influence of flow regimes and capital outlay. This gives rise to the following favorable operating characteristics:

- The evolved heat is removed where it arises with out local overheating, thus providing high selectivity.
- As a consequence of the short blend times, no zones with hydrogen depletion, thus conserving the catalyst and fewer byproducts.
- Shaft seal in the head space.

OPERATING RELIABILITY

Hydrogen has wide explosion limits. Hydrogen/air mixtures with a concentration range of 4–75 vol.-% hydrogen can be ignited. Furthermore, hydrogen is highly diffusive, which means that the entire apparatus must be absolutely gas tight. High pressures often necessitate special metal seals for all detachable connections.

The shaft seal of the agitator is particularly critical. Double- or triple-acting mechanical seals may have to

be used, depending on the operating pressure. Modern triple-acting mechanical seals with an installed pressure splitter can still operate reliably at pressures of up to 200 bar.

Due to the dangerous nature of many process media, the design of processing equipment must include adequate monitoring systems for the mechanical seals to guarantee their reliable operation.

If media with an extremely high hazard potential are involved in the process, magnetic drives can be used so that the vessel can be hermetically sealed using only static seals. Mechanical seals are then also used to seal the bearings against the product side of the vessel.

EXTERNAL CONDENSATION

Some reactions afford gaseous or vaporous byproducts, e.g. water. These include both gassed (e.g. amination reactions) and ungassed (e.g. esterification) processes.

Because esterification is an equilibrium reaction, water (one of the products) has to be removed from the reaction mixture to maximize both the yield and the reaction rate. This is particularly important towards the end of the reaction when the reaction mixture is already depleted in educts and small water fractions hinder the ongoing reaction due to the Law of Mass Action. Although these reactions are generally carried out above the boiling point of water, removal of water from the reaction mixture can be accelerated by means of an inert carrier gas (e.g. nitrogen). With conventional process engineering, the water enriched carrier gas is withdrawn from the headspace of the vessel and passed through an external condenser to remove the water. The gas is then blown back into the reaction mixture with a fan. However, this is associated with additional capital outlay and maintenance costs for the gas recirculation unit.

Alternatively, a self-aspirating agitator can carry out the function of the fan. In this case, the gas is not fed directly from the headspace back into the liquid, but is passed through an external condenser to purify it. Back-mixing with the unpurified gas mixture in the headspace is avoided by feeding the gas back into the reactor using a dip tube flanged under the agitator housing and concentrically about the shaft. This separates the returned purified gas from the headspace of the vessel. The self aspirating turbine recirculates the carrier gas out of the dip tube and into the liquid. If the waste gas cannot be liquefied, a different separating principle can be used instead of a condenser, e.g. a gas scrubber.

GAS/LIQUID REACTIONS ENHANCEMENT

Gas/liquid reactions are often limited by physical parameters such as mass or heat transfer. Reduced conversion rates and hence reduced productivities as well as increased byproduct formation are the consequences. State-of-the-art mixing technology with a combined gassing mixing system can overcome such limitations and contribute to an increased profitability of the process. ●

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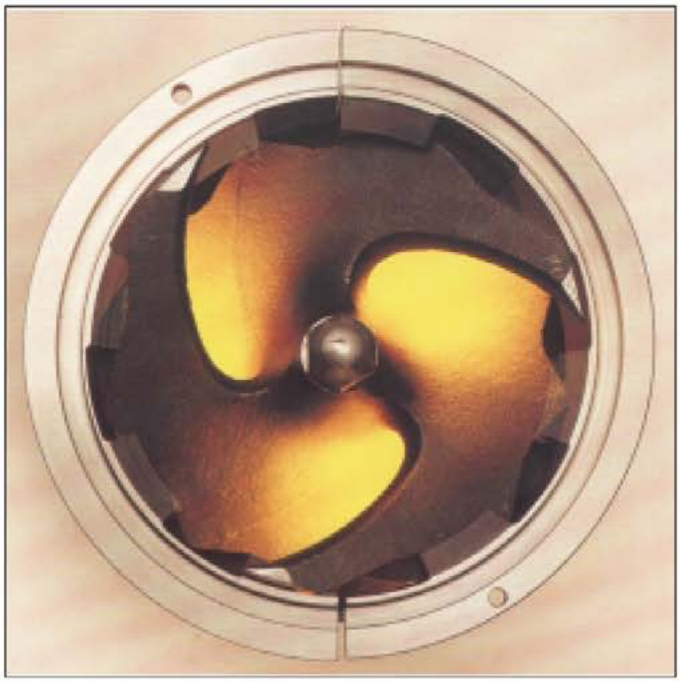

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Continuous Powder Wetting Ups Production

Modern inline mixing systems offer numerous advantages over conventional batch processes

VESSELS WITH stirrers are often used to achieve a homogenous mixture of solids and liquids. Industrial systems comprise a number of vessels, mixers and peripherals. Despite modern stirrer geometry and the possibility of increasing the speed of the mixer tools if required, the same problems always occur with batch systems, preventing a harmonious marriage of "solid and liquid."

Even with modern stirrers, ensuring a long-lasting, high-quality mix is a huge challenge. "Open" batch operation encourages the formation of agglomerates and dust. As a consequence, solid particles which have not been successfully mixed in are found on the stirrer shaft, vessel wall or vessel lid. This not only increases cleaning costs between the processing of different batches, but also prevents production of a mix of uniform quality. If air is used as a delivery medium for the solid, the possibility exists of unwanted air being entrained into the mix. Dust and solvent emissions are a problem from the point of view of workplace safety, as they present a potential health risk to employees.

It also can be financially attractive to look for alternatives to conventional batch process. Depending on the type of operation, some product components may be "treated" more than actually necessary in a batch process, others less. To obtain satisfactory product quality over the batch as a whole, lengthy mixing and/or dispersion is required. This increases energy consumption and produces significant heat in the products.

For all these reasons, modern continuous powder wetting systems are seen as increasingly attractive, even for relatively small quantities.

MIXING, HOMOGENIZING, DISPERSING

Figure 1. The IKA MHD plant operates as a continuous process when mixing liquids and solids.

SOLID AND LIQUID CONJOIN

Modern inline systems overcome the disadvantages of conventional batch processes. IKA MHD plant, for example, operates as a continuous process (Figure 1). Its name comes from the functions it performs: mixing, homogenization and dispersing of solid and liquid phases in a single pass.

In an MHD mixing and dispersing machine, the product components are dosed in the correct proportions, then mixed, dispersed and discharged (Figure 2). Dosage of

CONTINUOUS PROCESS

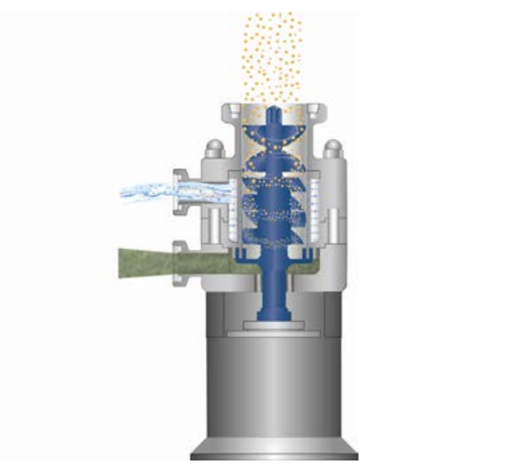

Figure 2. The module mixes, homogenizes and disperses solid and liquid phases in a single pass.

the solid in simple cases is via a volumetric dosage device. Here, dosage is dependent on the volume introduced per unit of time and remains constant for the same bulk density and uniform filling of the dosage hopper.

If greater accuracy is required or complex substances are to be input, gravimetric dosage is used. The various solids and dosage quantities are weighed on scales and compared with the pre-determined requisite amounts. Any discrepancies are automatically adjusted via a controlled drive. Changes in the bulk weight or material properties do not affect the dosage result. Consequently, concentration accuracies within 0.5% by mass or better can be achieved. The slightly higher dosage cost is offset several times over. On the one hand, only small reservoir capacities are required and, on the other, no additional mixing machines are necessary.

MIXING, HOMOGENIZING, DISPERSING

While the solid is fed into the MHD from above (Figure 3), the liquid component of the mixture is introduced into the processing chamber at the side, for example by means of a pump. The liquid is separated into a large number of individual streams in a special drum by means of a perforated injector nozzle and injected into a pre-mixing chamber. Gravity conveys the solid on to the spiral blades of a conveyor screw operating vertically downwards and feeding the solid into the mixing chamber, where it also acts as a "sluice gate".

The design of the MHD module prevents splashes of liquid from reaching the solid inlet area, thus reliably preventing lumps from forming and ensuring that no problems occur with feeding the solid into the machine.

The phases come together in the pre-mixing

PLANT FLOW DIAGRAM

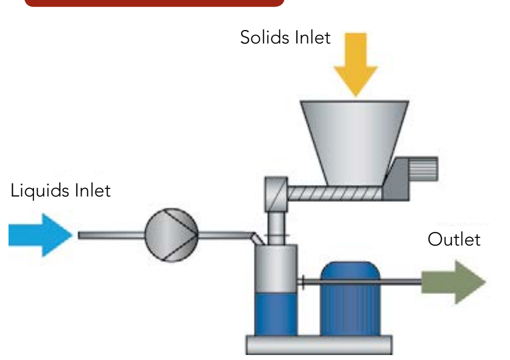

Figure 3. The solid is fed into the MHD from above, and the liquid component of the mixture is introduced into the processing chamber at the side.

chamber and are mixed efficiently by means of a special mixing tool. The multipart, high-speed mixing tool creates a highly turbulent flow in the mixing chamber and thus results in optimum wetting and mixing of the solid particles (Figure 4).

Up to three rotor-stator tool systems can be used in the bottom section of the mixing chamber in order to disperse the pre-wetted mixture finely or to break it down wet. Depending on the initial materials, very fine suspensions can thus be produced continuously in a single pass. The product leaves the processing chamber through the discharge outlet, where a delivery pressure of up to 2 bar can be created.

HIGHER SOLID INPUT

Depending on the product, up to 80% solid content can be input in a single pass. The MHD can produce

LIQUID PHASE

Figure 5. The IKA MHD 2000/30 machine enables a number of different molecules suited for the liquid phase, including water, oils, kerosene and alcohols.

SECTION VIEW OF MHD MACHINE

Figure 4. The multipart, high-speed mixing tool creates a highly turbulent flow in the mixing chamber.

anything from high viscosity products to pastes in the 50,000 mPas range. As the product only passes through the machine once, only a small amount of heat is generated and the product has only a short residence time in the machine. This is particularly important in the case of reactive processes and rapid increases in viscosity. The particle sizes in the suspensions produced by the MHD 2000 (Figure 5) depend on the initial materials and are frequently in the range approximately 10 to 100 µm.

INCREASE IN VERSATILITY

MHD machines suitable for sterile conditions are available for use in the food industry. The design and easy-to-clean components have 3A certification. On request, the MHD system can be supplied with silo, big-bag or sack emptying units or as a complete production line with all associated powder or storage

containers, pipe work and heating/cooling equipment. A full measurement and control system for automatic operation can also be supplied. The level of automation can be adapted to suit all requirements, from simple manual operation to a fully automated system.

VAST OPTIONS

MHD systems cover a broad range of applications. Sectors where they are used include the chemicals, cosmetics and food industries. Continuous, proportional quantity mixing is suitable for a great many initial products.

The following products are suitable for the liquid phase: water, oils, resins, kerosene, alcohols, liquid polymers, low to high viscosity dispersions, molten urea, syrup or solvents. The following solids can be mixed with the fluid in each case: starch products, Carbopol, Aerosil, nuts, ammonium sulfate, aluminum oxide, spice powder, talcum, mineral pigments, coating products, reactive powder, polyamide fibers, thickeners, cellulose, fuller's earth, carbon black, pectin, pellets, etc.

Suspensions with concentrations of 50% aluminum silicate, for example, can be produced in a continuous process. In the bleaching process used in the preparation of vegetable oils, the oil and the fuller's earth are combined in a single pass in the IKA MHD 2000 machine (Figure 5).

POLYMER-MODIFIED BITUMEN

Figure 6. Polymer-modified bitumen can be produced by the MHD plant, which is used for the construction of roads and high-quality roofing membranes.

INDUSTRY: PETROCHEMICALS / ROAD BUILDING

Liquid	Bitumen
Solid	Polymer (SBS)
End product	Polymer-modified bitumen for road building
Supplied as	Complete plant for the continuous production of 35,000 kg/h of polymer-modified bitumen

ADVANTAGES OF CONTINUOUS OVER BATCH PROCESSES

- Efficient energy input
- Machine-guided product flow
- Variable, multi-stage rotor/stator systems
- Narrow particle size distribution and good reproducibility
- Compact
- Flexible production quantities
- No dust and solvent emissions
- Easy cleaning
- Reliable scale-up
- Ideal for relatively large production volumes

A modified version of the MHD plant is used successfully in the production of polymer-modified bitumen (Figure 6). Here a polymer (generally styrene-butadiene-styrene) is added to the liquid bitumen which has been heated to approximately 180°C. The end product is used in the construction of roads and airport runways and also is in demand for high-quality roofing and waterproofing membranes.

SCALE-UP CAPABILITY

In times of increasingly short product cycles, efficient scale-up is ever more important. Scaling up new processes to the required manufacturing level has become one of the key disciplines in process engineering. Already at laboratory level, IKA pilot plants (Figure 7) give a realistic idea of the planned manufacturing plant, as the design is the same as that of the subsequent production-scale machinery and plant.

SCALE-UP

Figure 7. The IKA plant, is already at laboratory level and has a design same to that of subsequent production-scale machinery.

POWDER INPUT MODULE

Figure 8. IKA magic LAB with powder input module helps in selection of the process technology to be used in each case.

At the same time, IKA magic LAB (Figure 8), LABOR-PILOT and PROCESS-PILOT help in selection of the process technology to be used in each case. Interchangeable modules enable a wide range of process techniques to be used in response to actual requirements and formulations. The IKA pilots allow machine and plant sizes and the associated energy requirements to be defined. The required raw material quality and quantity can also be determined precisely at laboratory level.

And the most important question of all can be answered before scaling up: what quality characteristics should and must the end product possess? From the start, this gives project planners maximum certainty in planning and achieving a fully professional mix quality.

IKA- WORKS, INC., based in Wilmington, N.C., offers a vast spectrum of equipment for high shear mixing, dispersing, homogenizing, grinding, milling, emulsifying, size reduction and kneading applications. For more information, visit www.ikausa.com.

Mix it Up

Modern in-line mixers are more versatile, modular units that meet changing demands

TODAY'S PROCESSING equipment must be able to multi-task to earn a place in the modern production plant. The high-shear dynamic in-line mixer is well-suited both for processing multiple products and for handling variations in the formulation or the raw materials of a single product. All of this may be accomplished in a single pass through the high-shear in-line mixer, as part of a continuous processing system. To further enhance its versatility, the high-shear in-line mixer can be fitted with casters (Figure 1) so it is easily moved from one production line to another anywhere within the plant.

Some dynamic high-shear in-line mixers for the wet mixing and blending of emulsions, dispersions and mixtures feature a modular design. Such a design makes it possible to quickly and easily reconfigure the mixing head on-site in a matter of minutes with no special tools required. When offered with a variety of high-efficiency rotor and stator options, the modular mixing head provides an unsurpassed level of versatility. Such versatility results in significant savings in equipment costs.

MIXING OPTIONS

A modular mixing chamber can be configured with anywhere from one rotor and one stator for one shear action zone up to the maximum number of mixing elements the chamber allows. This may be as many as seven rotors and six stators for 12 shear action zones. Regardless of the configuration, no changes are necessary to the external profile and size of the mixing head. Simply choose the required number and type of rotors and stators to be installed in the existing mixing chamber housing. For a well-designed mixing chamber, there are no special tools or skills required to properly assemble the exact rotor/stator array needed for optimum performance in any intended application.

By combining a properly-configured rotor/stator array with an optional variable-frequency drive (VFD) to control the motor speed, it becomes a simple matter to

MIXING MOBILITY

Figure 1. Casters help easily move this high-shear in-line mixer from one production line to another anywhere within the plant.

VERSATILITY

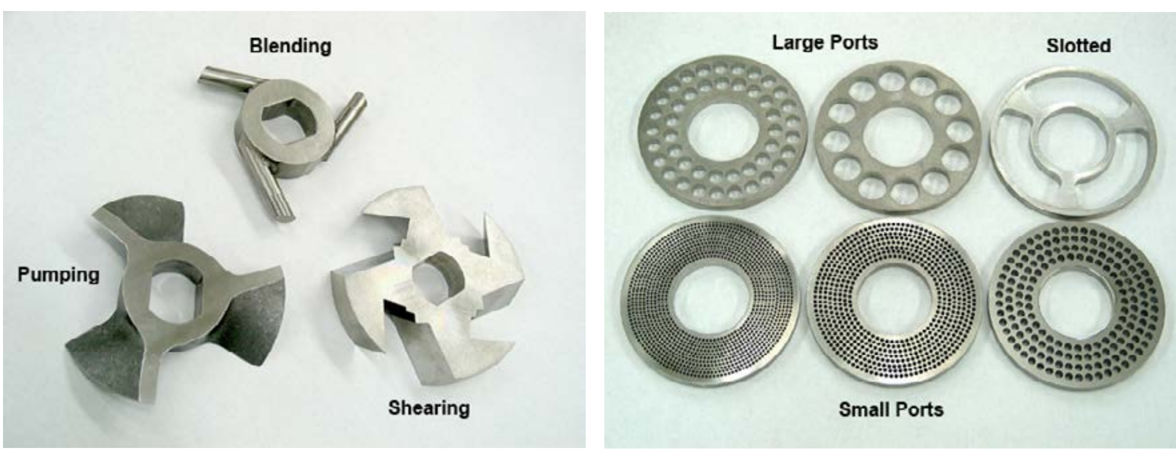

Figure 2. Modular mixing heads and a variety of port options offer numerous configurations for optimal performance.

vary the applied shear rate from very-low to ultra-high shear in precise increments, to provide the optimum shear rate conditions for each product. Such a state-of-the-art mixer can easily be the workhorse in any diverse manufacturing facility.

DESIGN IT RIGHT

To further enhance its multi-tasking versatility, it is important that the modular high-shear in-line mixer can be fitted with a broad range of mechanical process seal types and materials and with whatever inlet/outlet connections may be required. This ensures that the mechanical seal performs effectively regardless of the specific product being processed and that the in-line mixer can be easily connected into any existing piping layouts. Again, a properly designed dynamic in-line mixer will permit all of these various configurations to be implemented on-site in just minutes without any special tools and without any external modifications to the existing mixing head.

BEMATEK, based in Salem, Mass., manufactures multi-shear in-line wet mixers and colloid mills. For more information, visit www.bematek.com.

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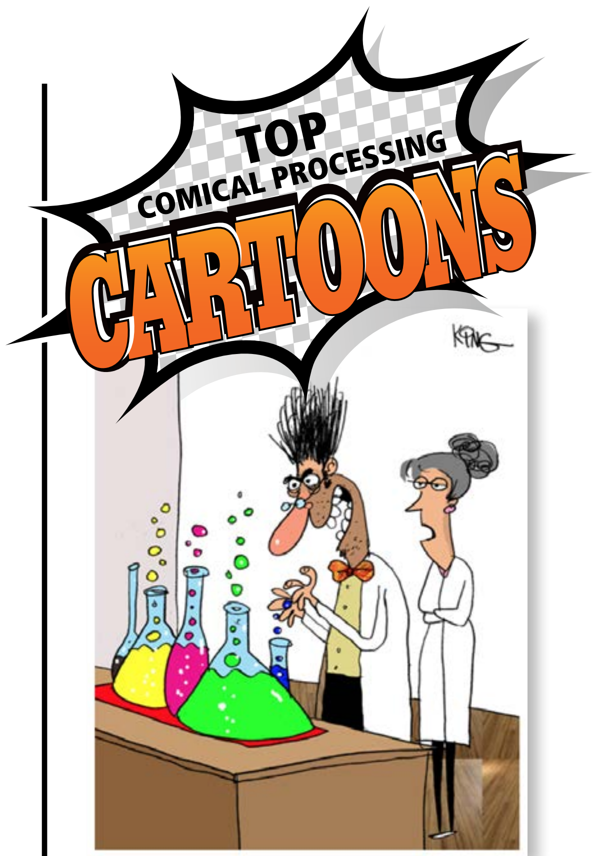

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