WWW.CHEMICALPROCESSING.COM

CHEMICAL PROCESSING

LEADERSHIP | EXPERTISE | INNOVATION

Powder eHandbook

75TH ANNIVERSARY

Optimize Powder Processing

Start ▶

PutmanMedia®

schenckprocess

Mac Process and Schenck AccuRate are now one

Together, we bring you unmatched systems for
pneumatic conveying, filtration, weighing and feeding

Industry leaders Mac Process and Schenck AccuRate have combined forces as one to deliver premier systems for your dry material handling process needs. From sanitary through heavy industrial applications, our custom solutions are engineered and work together to solve your most difficult challenges, efficiently and economically.

As a Schenck Process family company, we've integrated our sales, material testing centers, and over 100 engineers to deliver advanced products, designed and manufactured for 100% compatibility and accurate process control. Rely on the continuous high performance, reliability and smooth operation of your system, backed by global support. Our deep application knowledge has resulted in thousands of installations for multiple industries worldwide. Contact us with your dry material handling needs.

For pneumatic conveying and
air filtration inquiries contact:
Mac Process
7901 NW 107th Terrace
Kansas City, MO 64153
888-657-3098
sales@macprocessinc.com
www.macprocessinc.com

For weighing and feeding
inquiries contact:
Schenck AccuRate
746 E. Milwaukee Street
Whitewater, WI 53190
800-558-0184
mktg@sarinc.com
www.accuratefeeders.com

we make processes work

Table of Contents

Product Features

Tubular Drag Conveyor Maximizes Process Conveying

Flexible layout enables conveying on multiple planes

HAPMAN'S TUBULAR drag conveyor was designed to optimize process conveying. From delicate and friable material, to abrasive and course product, the tubular drag conveyor, with more than 100 industrial chain and flight options, handles any material type. The flexible layout allows for conveying on multiple planes and in any direction while conveying beneath floors, around doors and obstacles and through walls and ceilings.

With almost unlimited inlet and outlet designs, the completely sealed system keeps material in the process and eliminates plant and product exposure.

For more information, visit www.hapman.com

HAPMAN
www.hapman.com

Ad Index

System Discharges Bulk Bags

Bulk bag unloader is designed for pneumatic conveying systems

THE BULK Bag unloader from VAC-U-MAX provides a clean and efficient way to discharge the entire contents of a bulk bag. It's specifically designed for semi to non-free-flowing powders. VAC-U-MAX Bulk Bag Dischargers use our proprietary pneumatically operated massage paddles, operator access door for a complete sealed system, dust collection port, heavy-duty tubular frame, motorized hoist and trolley, and screw discharger for controlled metering of powders into the convey line or process.

For more information visit www.vac-u-max.com or call 800-VAC-U-MAX (822-8629).

VAC-U-MAX
www.vac-u-max.com

Weighing Solutions
Tailor Fit for your Applications

You may be surprised at the array of choices for weighing in the chemical industry. It can be a bit overwhelming to find the right solution, but with 112 years of experience we can help. We offer solutions from micrograms to hundreds of tons, hazardous areas to clean rooms, integrated solutions to stand alone systems.

To see what METTLER TOLEDO can do, download our Solutions and Competencies brochure.

▶ **Click to learn more**

METTLER TOLEDO

Streamline Your Chemical Process

Removing complexities that creep in over time can enhance operations

By Richard J. Beaman, Jr., Eric Hopkins and Clifford Reese, SSOE Group

SOME CHEMICAL makers are missing opportunities to reduce operating costs and increase profits because they aren't striving to re-engineer and streamline their processes. This doesn't mean starting from scratch. Instead, a plant often can achieve substantial benefits through simplified steps that do more and work better with less complexity.

The KISS — Keep It Simple and Straightforward — strategy is one of the most effective yet underutilized approaches to optimize a chemical process that has become complex over time. The need for increased capacity, reduced unit cost and equipment replacement often should prompt a fresh look at the whole process.

Two effective KISS strategies to remove process complexities are to combine parallel operations and multiple functions, and to eliminate redundant or inefficient controls. Here's how they can be applied.

COMBINED OPERATIONS

Many plants can simplify parallel operations. For example, one facility we looked at had two sets of reactors, each with its own brine feed system. When built, the facility only had a single set of reactors and associated feed system. However, a few years later, demand for increased capacity prompted construction of a duplicate set.

Both reactor sets now were fed by a single flow of salt slurry (Figure 1). A cyclone separator and splitter box above the tanks diverted flow to one tank until it reached its operating level and then switched flow to the second tank. In addition, a third outlet in the center of the splitter box fed any excess salt to the dissolver tank that sent brine back to the brine treatment system, treating it twice unnecessarily. The bottom of the cyclone contained a filling hose with a chain hooked to the handrail. When one tank became full of solids, an operator detached the hose from the handrail on one side of the splitter box and would swing it over to the other side of the splitter box to feed the other tank.

The need that created this system was real — but the arrangement led to numerous operational inefficiencies.

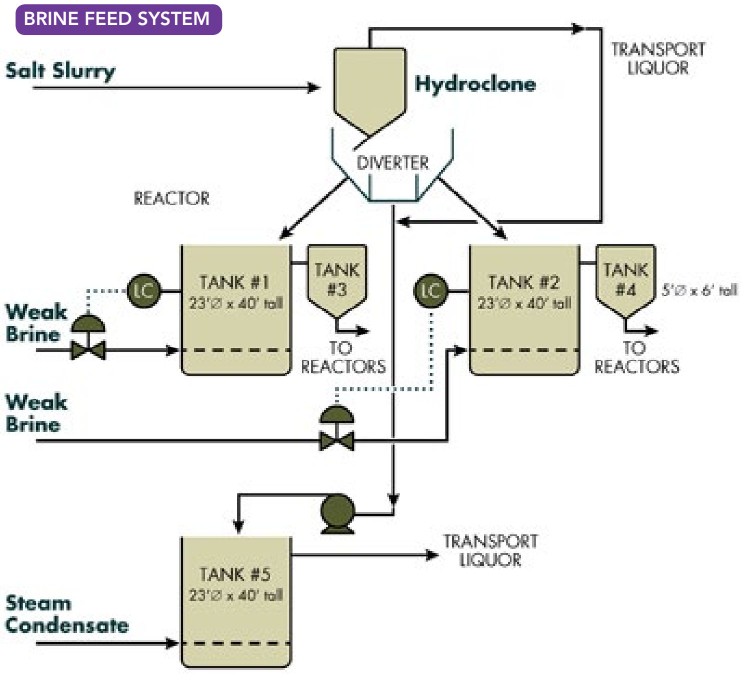

Figure 1. Complexities, including sequential filling of tanks and unnecessary recycle, compromised efficiency and control.

tigerflex®

Thermoplastic Industrial Hoses

VOLTBUSTER™

Superior Static Protection™

Static Dissipative Food Grade Material Handling Hoses

Superior Static Protection!
Durable Abrasion Resistant!
Food Grade! Light Weight!

NEW PRODUCTS!

EDITION 1203

Kuriyama of America, Inc.

TIGERFLEX

Made in USA

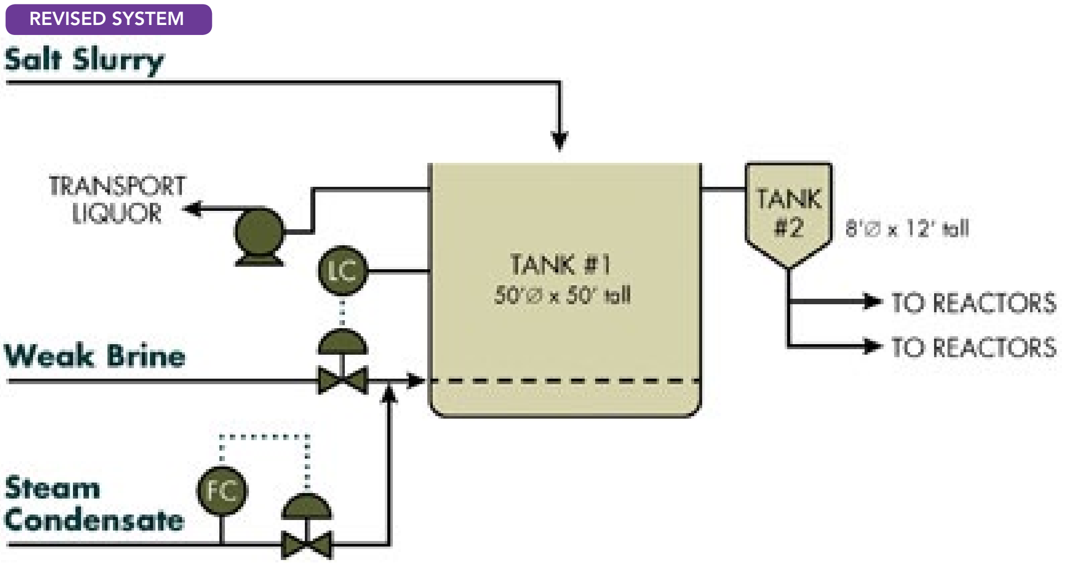

Figure 2. Simplified setup contains fewer pieces of equipment and also features better corrosion protection for the brine tank.

While the tank walls and floor were sound, the welding rod material used for the tank's seams wasn't resistant to some components in the brine solution and would repeatedly corrode. As a result, every few months the plant had to shut down the reactors to re-weld seams.

At least once per shift the cyclone separator had to be flushed to clear out solids' buildup. Moreover, constantly moving the filling hose — with the attendant sudden addition and removal of salt feeds — caused upsets in the brine-saturation-tank level controllers. This led to abrupt changes to the flow rate of

Hoses Suit High Static Applications

Lightweight material helps minimize work injuries

TIGERFLEX™ VOLTBUSTER™ food grade material handling hoses are designed for high static applications such as the transfer of powders, pellets and other granular materials.

The hose effectively dissipates static charges to ground, helping prevent static build-up and reducing the potential for dangerous electrostatic discharges.

While rubber and metal hoses could increase the risk of muscle sprain or strain due to their heavier weight, the Tigerflex Voltbuster hoses are lightweight and flexible for worker safety.

The hose tubes are constructed from highly abrasion-resistant food-grade polyurethane to ensure the purity of transferred materials. In addition, the grounding wire is encapsulated in a rigid PVC helix on the exterior of the hose, safely eliminating the risk of contaminating the transferred materials.

KURIYAMA
www.kuriyama.com

CURRENT CONFIGURATION

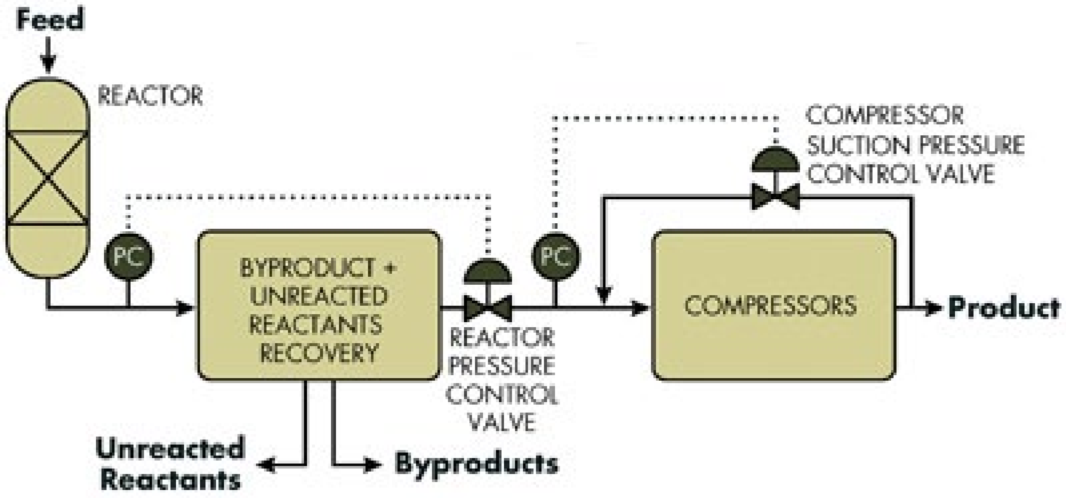

Figure 3. Viewing operation as consisting of two separate procedures led to use of two control valves.

the weak brine used to cool a byproduct gas stream, which in turn altered the temperature of the byproduct gas, prompting the byproduct gas compressors to trip offline.

Alternating the salt slurry between tanks was a problem, too. The salt level in the tanks decreased as the weak brine dissolved it, so the brine leaving the tanks became too weak, reducing reactor efficiency. In addition, operators had to invest a full shift twice a week to clean the salt recovery equipment.

Although the problems seemed endless, extensive discussions among the team of internal engineers, the consulting process engineers and key operations personnel produced a simple solution: combine the parallel operations to create one continuous process.

The process includes a new brine saturation tank that feeds both reactor sets and a single new feed neutralization tank fitted with two outlets, and combines the brine-saturation and excess-salt-dissolver operations (Figure 2). The solution also incorporates new specifications for active cathodic corrosion protection of the brine saturation feed tank — it has thicker walls and welds protected with a trowel-applied lining. The salt-slurry cyclone separator, splitter box and excess-salt dissolver tank all were eliminated.

The changes have provided a number of substantial benefits:

- elimination of corrosion as verified by subsequent checkups over time;
- increased byproduct gas recovery to 93% from 85%;
- improved reactor efficiency due to nearly 100%-strong brine availability;
- decreased operating complexity; and
- reduced maintenance because of the significantly lower quantity of equipment.

This solution illustrates that sometimes it's necessary to go beyond thinking about fixing the problem to thinking about a more straightforward way to do the process.

SIMPLIFIED CONTROL

Unnecessary complexity also can afflict control systems. For example, when working up a design for additional processing capacity for a reactor effluent gas stream, the consulting process engineers noticed opportunities to simplify the existing control system.

Typically, the system for recovering byproduct from the reactor was viewed as having two separate

HAPMAN
Ideas that move

Your Decision. Your Equipment Purchase.
YOUR Signature on the Dotted Line.

Relax. You're Getting a Hapman.

When making a capital equipment requisition for your company, you need to have 100% confidence in not just what you're buying, but who you're buying it from. That's why Hapman matches your trust in us with proof of our commitment to you – a 100% operational guarantee. Hapman engineers work as part of your process design team, putting our extensive industry and material handling expertise to work for you. The result is the best, most comprehensive equipment selection for your specific process.

Performantee®
Designed for results – guaranteed.

Vacuum
conveyors

Helix® Flexible Screw
conveyors

Tubular Drag
conveyors

Bag Dump
stations

Volumetric/Gravimetric
feeders

Bulk Bag
unloaders

Bulk Bag
fillers

Call: (800) 427-6260 **E-mail: sales@hapman.com** **Visit: www.hapman.com**

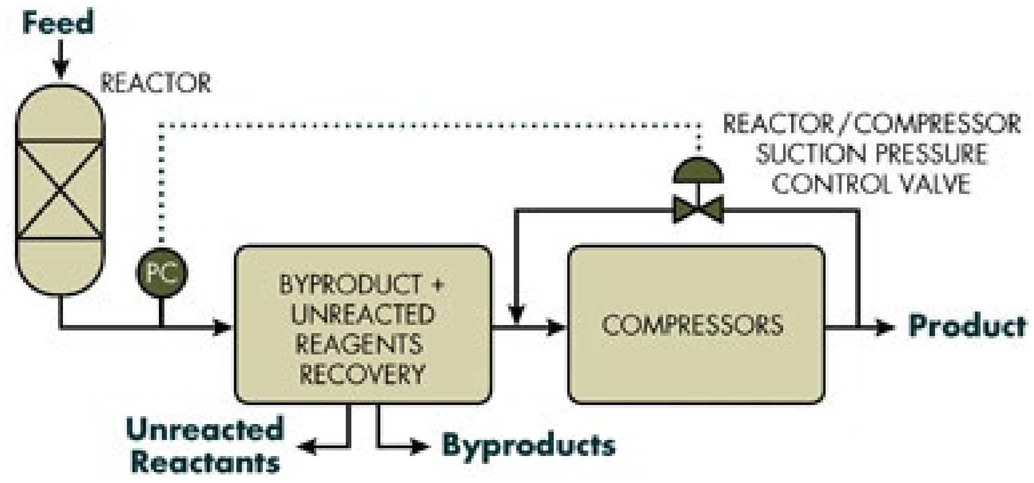
PROPOSED CONTROL SCHEME

Figure 4. Regulating pressure via a single control valve enables use of a slightly smaller compressor and affords better control.

procedures, reaction and compression, and was designed with separate control valves for each. As byproduct from the reactor made its way to the compressors that processed the end product, it first was cycled through an intermediate recovery unit where a dedicated valve controlled the pressure of the reactor. Downstream of that valve, another control valve on the compressor's discharge recycle line regulated compressor suction pressure. In this configuration, the pressure was controlled on both sides of the control valve (Figure 3).

Viewing the two processes as one continuous system led to a straightforward solution — eliminating the upstream valve and controlling pressure only with one properly sized valve in the compressor's discharge recycle line (Figure 4). This also allowed for a slightly smaller compressor that optimally handles a higher suction pressure and better controls the volume flow of the compressor feed stream. The change supported a continuous flow at a rate that met the increased capacity requirement.

COMMON CONCERNS

Process simplification means change — and that can raise objections. People resist because they're invested in the existing process, worry about the reliability of the new configuration, or even fear job losses.

Engineers experienced in simplification don't dwell on criticizing the existing process, but instead focus on the benefits of the improvements and, when possible, how to implement them in a phased way if that better suits the situation.

A question that often arises during streamlining efforts is: "What if the line breaks down, then what?" When the solution stems from a holistic team-based approach, the ability to see the sound technical basis of simplification surfaces more readily. The notion that separate processes creating daily operational problems and frequent maintenance are more reliable than a single continuous process becomes moot, especially when engineers have experience with streamlining and can cite successful implementations.

Converting the brine feed process to a straightforward one required fewer pieces of equipment, increased the efficiency of the brine saturation process, and eliminated controller upsets and byproduct compressor trips. The higher byproduct recovery rate boosted the profit on its sale.

Similarly, eliminating the controller in the reactor process allowed for a smaller more-efficient compressor to regulate the feed stream volume in such a way

that controlling pressure separately at both ends of the process wasn't necessary; the simplification cut cost while raising production.

The aim of process simplification is to improve efficiency and achieve operating savings, not to eliminate jobs. Indeed, streamlining may enable redeploying staff to higher-value activities.

EMBRACE THE OPPORTUNITY

Succeeding at process simplification doesn't demand "reinventing the wheel." Rather, it requires focusing on how streamlining can improve a process. The KISS strategy can identify straightforward changes for enhancing the efficiency and profitability of a chemical process. Not every system will derive a huge gain from process simplification — but most can realize some benefits from adapting proven solutions.

Remember, as a process gets increasingly streamlined and simplified, so, too, do training and maintenance. As a result, further opportunities for improvement become easier to recognize.

RICHARD J. BEAMAN, P.E., is a Midland, Mich.-based senior chemical process engineer with the SSOE Group. **ERIC HOPKINS, P.E.**, is a Cincinnati, Ohio-based senior chemical process engineer with SSOE. **CLIFFORD REESE, P.E.**, is a Midland, Mich.-based business leader and senior associate with SSOE. E-mail them at Rick.Beaman@ssoe.com, Eric.Hopkins@ssoe.com and Cliff.Reese@ssoe.com.

Versatile Feeder Handles Bulk Solid Materials

Disassembly feature eases cleaning and maintenance

THE MECHATRON dry material feeder from Schenck AccuRate has all the unique design features that manufacturers require for their processing applications. Complete disassembly from the non-process side of the feeder eliminates the need to remove upper extension hoppers, bins, bulk bags and IBC's to clean or maintain the feeder. Flexible or stainless steel hoppers are available to accommodate any application.

The feeders are suited to handle a range of volumetric or gravimetric feeding applications such as TiO2, wood flour and carbon black. The MECHATRON can achieve feed rates from .002 to 1,100 ft^3 per hour.

For more information, visit www.accuratefeeders.com/mechatronfeeders.html

SCHENCK ACCURATE
www.accuratefeeders.com

The Smartest Distance Between Two Points....

Pneumatic Conveying Systems by VAC-U-MAX

VAC-U-MAX is a premier manufacturer of custom pneumatic conveying systems and support equipment for conveying, vacuum conveying, batching, and weighing materials. With a VAC-U-MAX pneumatic conveying system on site, your company's product can move gently and quickly from point to point, with nothing in the way to impede the efficiency of its movement.

- Dilute Phase Vacuum Conveying Systems
- Dense Phase Vacuum Conveying Systems
- Dilute Phase Positive Pressure Conveying Systems
- Dense Phase Positive Pressure Systems
- Multi-ingredient Handling
- Batch Weighing Systems
- Bulk Bag Unloading
- Bulk Bag Loading
- Bag Dump Stations
- Vacuum Conveyors
- Aero-Mechanical Conveyors
- Flexible Screw Conveyors

Pneumatic Conveying Systems * Bulk Bag Unloaders * Bag Dump Stations * Flexible Screw Conveyirs * Aermechanical Conveyors

VAC-U-MAX

69 William Street
Belleville, NJ 07109
T:973-759-4600 * F: 973-759-6449
info@vac-u-max.com

www.vac-u-max.com or call 800-VAC-U-MAX (822-8629)

Suppress Explosions for Process Protection

A properly designed and engineered suppression system offers many advantages

By Jef Snoeys, Fike Corp.

CONSIDER A variety of reasons for applying explosion protection: OSHA and EPA compliance issues, corporate safety directives, pressure from insurance companies, process changes, technology improvements and more. But the most important reason is a bit more basic: doing the right thing to provide for the safety of employees and the facility in which they work.

For years, explosion venting has been the primary strategy for explosion protection. However, improved protection technologies, increasing public awareness and stiffer regulations from EPA, OSHA and NFPA all point to considering alternative, or additional, protection strategies and systems.

Explosion suppression is a technique whereby combustion of an explosive atmosphere in a closed, or essentially closed volume, is detected and arrested during incipient stages, thereby restricting development of damaging pressures. Explosion suppression offers many advantages as a protection method. First, suppression stops the deflagration before developing pressure can damage the process equipment. In addition, it controls any ensuing fire and reduces the propagation of the flame front to other process equipment. Because explosion suppression doesn't vent flame or other material, it's the solution of choice when toxic materials are being handled, equipment is located indoors, or venting exposes personnel to discharge of pressure and flame. Explosion suppression systems utilize electrical and mechanical components that can be adapted easily to most processes and are maintained in an active condition with continuous electrical supervision of components.

USING EXPLOSION SUPPRESSION TO PROTECT YOUR PROCESS

A properly designed and engineered explosion suppression system offers a variety of distinct advantages:

- Extinguishes the flame within the equipment, preventing fire damage
- Helps prevent pressure piling and secondary explosions with interconnected equipment (especially when used in conjunction with explosion isolation systems)
- Complies with NFPA regulation barring venting of explosions indoors. (Explosion vents must be discharged to a safe location. Indoor applications are difficult to vent — even with discharge ducts.)
- Retains toxic or valuable materials within the process equipment
- Integrates with the process controls to enable other protection devices, process shutdown and remote annunciation devices
- Suppresses Class ST III dust hazards, the highest level of industrial explosion
- Greater latitude in protection strategies, and process operations

HOW EXPLOSION SUPPRESSION WORKS

In many ways, explosion suppression systems function like automatic fire suppression systems, although much faster. An explosion suppression system is comprised of explosion detectors, explosion suppressors and a central control and annunciation system. Following detection of the incipient explosion, the suppressant agent is released from a pressurized vessel and distributed quickly and evenly throughout the vessel to be protected. Because the suppressant agent creates an atmosphere that will no longer allow explosion propagation, the damaging pressures from the explosion will not develop. This suppression sequence is illustrated in Figure 1.

In explosion venting, the reduced explosion pressures are designated as P_{red}. For suppression, the final pressure within the protected equipment is designated as TSP or Total Suppressed Pressure. In both cases, the equipment strength must be above these levels in order to avoid damage from an explosion.

An explosion is regarded as suppressed when the total suppressed pressure is lowered to a maximum reduced (suppressed) explosion overpressure $P_{red,max}$ or TSP of typically between 3 to 7 PSIG (20 to 50 kPa). For most practical applications of explosion suppression the worst case maximum TSP that can result is predicted by calculation. Provided that this suppressed explosion pressure is lower than the process equipment design strength, effective explosion suppression can be assured.

It's important to note that the pressure time relationship as shown in Figure 2 is fuel specific and knowing the explosibility characteristics of the potential dust, gas or hybrid fuel is necessary to design an effective explosion suppression system. The parameters of interest are the maximum explosion pressure (P_{max}), and maximum explosion pressure rate of rise (dP/dt or K_{ST}). These values are obtained from standardized laboratory tests.

EXPLOSION SUPPRESSION SEQUENCE

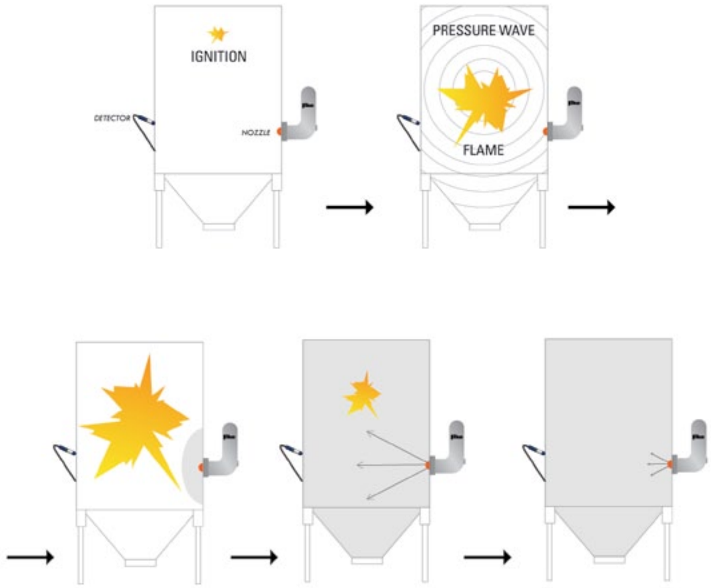

Figure 1. A typical explosion suppression device prevents developing pressure from damaging process equipment.

PRESSURE TIME HISTORY

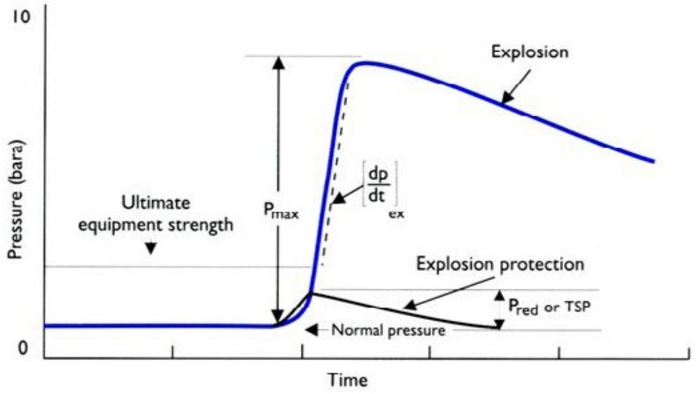

Figure 2. When designing an effective explosion suppression system, it's important to know the typical pressure time history of a suppressed explosion.

Figure 3. Pressure detectors with ceramic diaphragms are preferred because of their mechanical and chemical resistance.

SYSTEM DESIGN

Explosion suppression can be used on many different types of process equipment such as dust collectors, cyclones, driers, mixers, pulverisers and shredders. The dimensions of the protected equipment can range from 0.5 to 1,000 m^3.

Explosion system design should be performed by qualified professionals trained to understand how to relate relevant explosion and process characteristics to the suppression systems performance, in order to apply this knowledge and design the protection system solutions. Besides selecting the type and number of suppressors and the suppressant agent, the most appropriate means of detection and hardware to warrant effective distribution will have to be selected.

Detection. Any physical characteristic that will give evidence of an explosion in its early stages, can be detected. Absolute values or rate of pressure or temperature rise have been used, in addition to the detection of infrared (IR) and ultraviolet (UV) radiation levels. Although optical detectors are extremely fast and sensitive, they are an in-line-of-sight system, and multiple detectors would have to be used to see all of the locations where an explosion might occur. The most universally applied detectors are those relying on pressure, and ceramic diaphragms are preferred because of their mechanical and chemical resistance. Typical pressure detector activation pressures for applications that operate at or near atmospheric pressure, range from 0.5 PSIG (3.5 kPa) to 1.5 PSIG (10 kPa). Where pressure fluctuations are expected, or where the normal operating pressure is above atmospheric, a pressure rate-of-rise unit may be required.

Suppressant. The effectiveness of the suppressant used and the compatibility of the suppressant with the process must also be considered. Testing determines the effectiveness and performance of the suppressant, which then quantifies the applicability of a particular type of suppressant. Other important considerations include food compatibility of the suppressant, ease of removing the suppressant from the process and the suppressant's temperature stability.

Water and carbon dioxide, two popular materials for extinguishing fires, are not generally utilized for explosions. Aside from a possible reactivity with the chemicals in question, relatively large quantities of water would be necessary to limit reactions. Carbon dioxide has a low effectiveness–weight ratio and would require large storage units. Materials have also been known to reignite after having been extinguished by CO_2. Halogenated compounds, mostly methane derivatives, are popular suppressants but pose environmental issues and may chemically react with the hazard.

The most commonly used suppressants are dry inert suppressant powders such as sodi-


CAUTION
CAUTION
CAUTION
CAUTION
CAUTION

umbicarbonate (SBC), and mono-ammonium phosphate (MAP). Figure 4 shows a dataset of experiments conducted with cornstarch. The inertant dusts used were sodium bicarbonate (SBC), mono-ammonium phosphate (MAP) and rock dust (RD). Note the outspoken form of the SBC suppressant curve which resembles a classical flammability curve, clearly showing the superior suppressant efficiency of SBC against the hazard of cornstarch.

Suppressors. Suppressors or extinguishers are typically available in a range of volumes from 2.5 to 50 L and are mounted outside of the equipment on a flange. They are usually pressurized with nitrogen to 900 PSIG (6,200 kPa) and are fitted with a rupture disc or diaphragm that's opened by a contained explosive charge (see Figure 5).

Suppressors have been reported which use an electromagnetic means of opening, typically releasing a flap instead of breaking a disc. Due to the high speed at which the pressure rises during an explosion and to the relatively long time needed to obtain full opening of such valves, it's believed that they are too slow to protect against moderate- to fast-developing explosions.

A fairly recent development is the use of gas cartridge actuators instead of explosive detonators to initiate the opening of the rupture disc (see Figure 6). These self-contained gas generators have proven to be as fast as detonator-operated valves but are less hazardous and easier to transport and handle.

MINIMUM INERTING CONCENTRATION

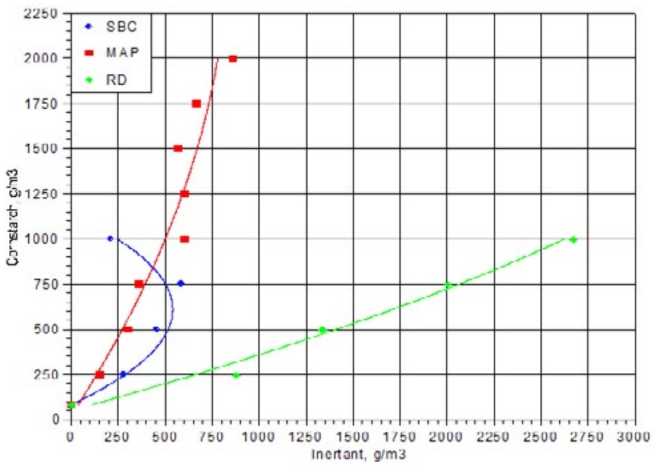

Figure 4. Each Application of hazard must be defined as to the minimum inerting concentration (of fuel and suppressant) below which explosions are possible and above which they are not (example shown: cornstarch in a 1m^3 explosion chamber).

SUPPRESSANT SYSTEM

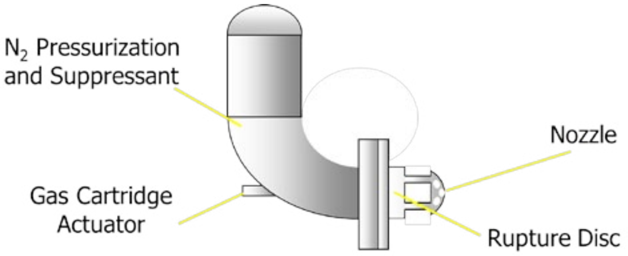

Figure 5. Suppressors are pressurized with nitrogen and fitted with a rupture disc or diaphragm that's opened by a contained explosive charge.

SUPPRESSANT DEVICE

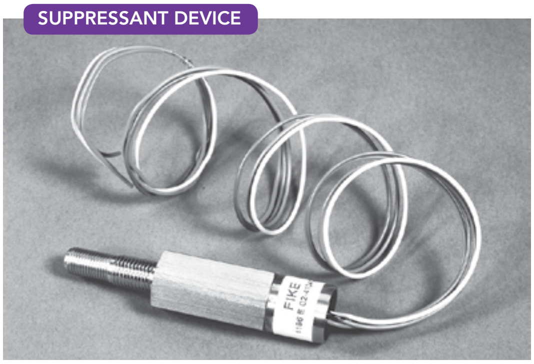

Figure 6. Gas cartridge actuators use explosive detonators to initiate the opening of the rupture disc.

Nozzles. To ensure a uniform suppressant distribution in the vessel to be protected, dispersion nozzles, fitted with protected caps are mounted to extend into the vessel (see Figure 7). Traditional suppression systems used “pepperpot” style nozzles which aren’t very suitable for powder-based suppression systems. Instead, nozzles with large openings in the top and sides have been developed to ensure a hemispherical, fast and uniform distribution of the suppressant (see Figure 8).

Many processes, particularly in the food and pharmaceutical industries, require the use of hardware that prevents the buildup of material. This provides optimum processing and easier cleaning of the equipment (CIP). To address these needs, telescopic nozzle arrangements have been developed which are flush mounted and typically use a silicone, Teflon or stainless steel nozzle cover. The nozzle functions by moving from the flush position to a position inside the protected area when the system is activated.

NOZZLES

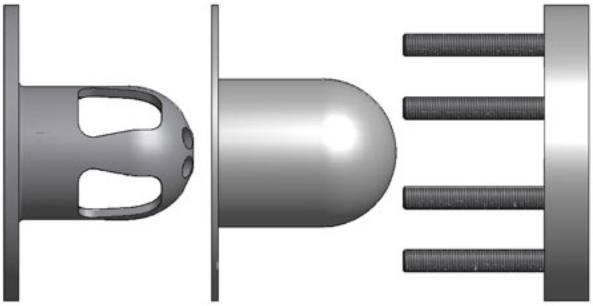

Figure 7. Dispersion nozzles fitted with protected caps are mounted to extend into the vessel to ensure uniform suppressant distribution.

POWDER DISTRIBUTION

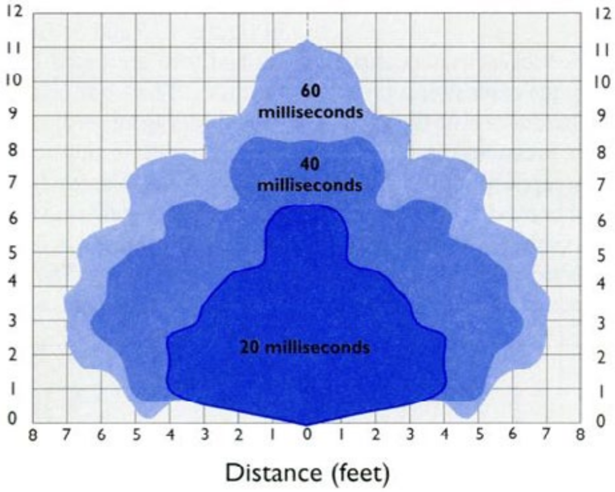

Figure 8. Hemispherical suppressant powder distribution is attained when using nozzles with large openings in the top and sides.

LARGE-SCALE TESTING

Understanding the explosibility characteristics of a particular process media, or other explosion hazard, is typically the first step toward obtaining effective protection. However, large-scale testing is required to validate the interaction between the dynamics of explosion propagation and the suppression system hardware to achieve TSP within the strength limitations of the equipment.

Large-scale tests are conducted with test chamber volumes that are similar to the volumes of industrial equipment (Figure 9). Explosion chambers with volumes from 0.5 to 250m^3 have been used to validate large-volume suppression. In these chambers, explosions with K_{ST} values of up to 550 bar.m/s are generated and the explosion suppression system is allowed to react independently to these explosions. Experimental parameters of importance are volume, K_{ST}, Pact and size and number of suppressant discharge containers used. Figure 10 shows a dataset obtained by varying the number of containers used to suppress a K_{ST} 300 bar.m/s hazard in a 25 m^3 vessel.

From the experimental data, the minimum number of HRD-suppressors, N_S, required to effectively suppress an explosion of a defined explosion violence using the ISO method of dust distribution in a given volume, V, can be determined using following equation: $N_S = N_o .V^{2/3}$.

When selecting an explosion suppression supplier, check the availability of efficiency numbers to ensure that large-scale-suppression testing has been performed and that the protection requirements are met. It's advised to work with your selected explosion protection provider to relate relevant explosion and process characteristics to the suppression systems performance. It's common practice to use CAD software tools to solve complex problems and design the optimum suppression system.

LARGE-SCALE TESTS

Figure 9. A 250-m^3 explosion test chamber fitted with Fike 50 L suppressors (white colored containers) is used for large-scale testing.

REDUCED PRESSURE

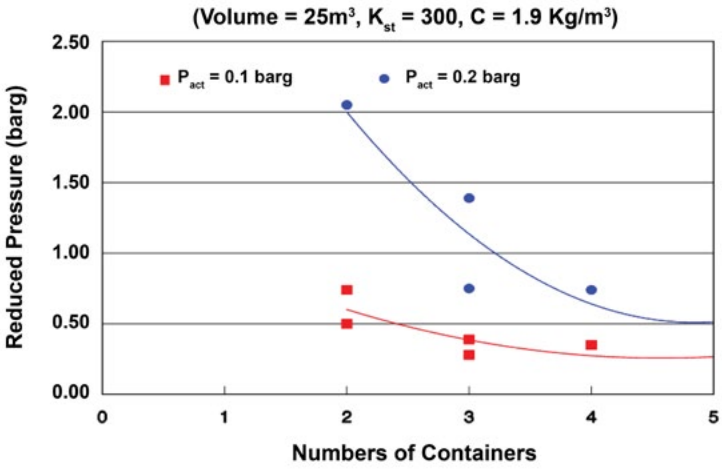

Figure 10. Containers used to suppress a K_{ST} 300 bar.m/s hazard in a 25 m^3 vessel.

EXPLOSION ISOLATION

Explosion isolation systems are designed to work in conjunction with both venting and suppression protection methods, by preventing the deflagration from reaching other areas through interconnected process pipes or ducts — placing the connected equipment and facilities at risk for secondary explosions. These secondary explosions are often the cause of the most severe damage and loss of life. Explosion isolation systems prevent the propagation of flame through the use of fast-acting valves or chemical barriers, effectively eliminating secondary explosions.

Mechanical explosion isolation involves the use of uniquely designed mechanical valves which provide an actual physical barrier to prevent the spread of an explosion through connecting pipework.

Chemical explosion isolation is achieved through a rapid discharge of a chemical explosion suppressant to prevent the flame from continuing through to other areas of a process system. An explosion detector initiates the release of the extinguishing agent when it detects a deflagration pressure or flame front, preventing the propagation of flame and burning materials.

Regardless of other protection measures, explosions must be prevented from propagating to other locations within the facility.

EXPERIMENTAL DATA

D of outlet	**101.4 mm (4”)**				**152.4 mm (6”)**	
K_{max} (m.bar.s-1)	5 l HRD	10 l HRD	20 l HRD	30 l HRD	25 l HRD	50 l HRD
200	0.99	0.49	0.27	0.23	0.19	0.15
300	0.99	0.57	0.35	0.31	0.26	0.22
D = Diameter						

Figure 11. Values of the constants N_o for the Fike explosion suppression system using HRD-suppressors with 4-in. (101.4-mm) and 6-in. (152.4-mm) outlets (dry powder suppressant; Ps = 62 bar; V = 1-1000m³).

SAFETY IN SPEED

With any explosion protection system, speed is paramount. Detection, control and releasing functions must be completed within a few milliseconds. With proper system design and a response in milliseconds, a suppressed explosion is limited to a typical pressure increase in the range of 3 to 7 PSIG. The reduced pressure limit brought about by suppression is very short in duration and minimizes equipment damage while optimizing personnel safety. Additional advantages are seen when toxic materials are being handled, equipment is located indoors, or venting exposes personnel to discharge of pressure and flame. However, the increased cost over a passive (venting) solution, is incremental and maintenance is required to ensure overall system readiness and reliability throughout the lifecycle of the suppression system.

JEF SNOEYS, MSc, has been with Fike Corporation since 1993 and is currently the Manager of the Explosion Protection Technology Group. Jef has carried out consultancy work worldwide in dust explosion protection, notably in the pharmaceutical, food and chemical industries, providing risk assessment reports and safety audits. He can be reached at jef.snoeys@fike.com.

BIBLIOGRAPHY

Instrument and Automation Engineers’ Handbook (IAEH). 4th Edition

Chatrathi, K. ; Going, J. *Dust Deflagration Extinction*, AIChE 2000

Chatrathi, K. ; Safety and Technology News, Fike, Volume 7 issue

THE SOURCE ... for Pharmaceutical, Chemical, Plastics, and Related Process Equipment.

Federal Equipment Company

(877) 536-1538 or
www.fedequip.com

Pharmaceutical and Chemical Manufacturing Equipment

Federal Equipment Company has more than 50-years experience in the processing equipment industry, providing quality used equipment, outstanding service, and competitive prices to chemical, pharmaceutical, plastics, and related process industries. Major markets include API, speciality and fine chemical, bulk chemical, and pharmaceutical and biopharmaceutical manufacturing, including solid dose, liquids, powders, aseptic filling, and packaging.

In addition to thousands of pieces of equipment in stock and ready to ship, Federal Equipment offers specialized services including the liquidation and auction of process lines and manufacturing facilities, equipment appraisals, rigging, testing, and auction services, as well as managing the negotiated liquidation of surplus equipment.

Federal Equipment is your source for Pfizer process and packaging equipment. Go to fedequip.com and check out the latest additions to our inventory from Pfizer sites around the world.

Buy the best, from the best!

Your Source for Pfizer Surplus Equipment

- **Blister Lines**
- **Bottling Lines**
- **Capsule Fillers**
- **Centrifuges**
- **Coating Pans**
- **Dryers**
- **Filters**
- **Fluid Bed Dryers**
- **Fluid Bed Granulators**
- **High Shear Mixers**
- **Lab Equipment**
- **Mixers**
- **Tablet Presses**
- **Tanks**
- **Roller Compactors**

39” APV Pilot Spray Dryer, S/S

10 Liter GEA Collette NV High Shear Mixer, UltimaGral 10, 316 S/S

Contact Us At 1.800.652.2466 or by Email at pharmaceutical@fedequip.com to get a Fast Quote.
View Our Entire Inventory Online at www.fedequip.com

8200 Bessemer Ave. • Cleveland, Ohio 44127 • T (800) 652-2466
www.fedequip.com • pharmaceutical@fedequip.com

Measure with Confidence

The correct weighing system and a proper maintenance schedule can ensure accuracy

By Steven Wise, Mettler-Toledo

FROM MEASURING raw ingredients to verifying the final product packaging, industrial scales play a critical role in the manufacturing process. But how do you know that the scale used in your process is the correct one and what the proper maintenance schedule is for your application, applicable regulations and location? The Good Weighing Practice (GWP) methodology from Mettler-Toledo, a global manufacturer of precision instruments for use in industrial applications, can help answer these questions.

MEASUREMENT UNCERTAINTY IN WEIGHING

GWP is based on the concept of measurement uncertainty. Any measuring device, whether it's a ruler, a speedometer, or a scale, has some measurement uncertainty associated with it. Uncertainty means that no measurement is perfect, but is always distorted by random errors and unknown systematic errors. It's expressed as an error associated with the weight (10 lbs ± 0.001 lbs).

As with any measurement device, uncertainty directly affects the accuracy of the reported value in a weighing system (see Figure 1). The error is less significant when you are weighing something large relative to the capacity of the scale. However, as you attempt to weigh something smaller and smaller on the scale, the relative uncertainty becomes more and more significant. At some point, the relative uncertainty is so significant that you lose confidence in the reported weight value.

For example, suppose you have a scale that's accurate to plus or minus 1 gram. At 10,000 grams (10 kg), this uncertainty represents one hundredth of one percent (0.01%) of the weight. In many situations, that uncertainty is small enough that it won't affect quality. Now suppose you're weighing a 10 gram sample on this scale with an uncertainty ± 1 gram. Now the uncertainty represents a full 10% of the reported weight. Your actual sample may be 10% larger or 10% smaller than what this scale is reporting just due to the uncertainty.

In the same way that you can't use a standard 12-inch ruler to measure the width of a human hair, you cannot use a truck scale to weigh a feather accurately.

FACTORS AFFECTING UNCERTAINTY

The measurement uncertainty of a weighing system is a combination of many factors. The readability, sensitivity, repeatability, non-linearity and eccentricity of the scale are all factors affecting measurement uncertainty and are associated with the scale design. The scale manufacturer can calculate the uncertainty of the weighing system associated with these factors.

However, the environment in which the scale is used also impacts the uncertainty of the weighing system. The environment is unique to every scale installation and cannot be calculated at the time the scale is manufactured. Significant impacts from the environment on weighing uncertainty can be attributed to wind, dirt, dust, temperature fluctuations, vibrations and operator errors among other factors. The only way to calculate the measurement uncertainty associated with the environment is to test the scale installed in the environment using the appropriate tools and methods.


EXKOP

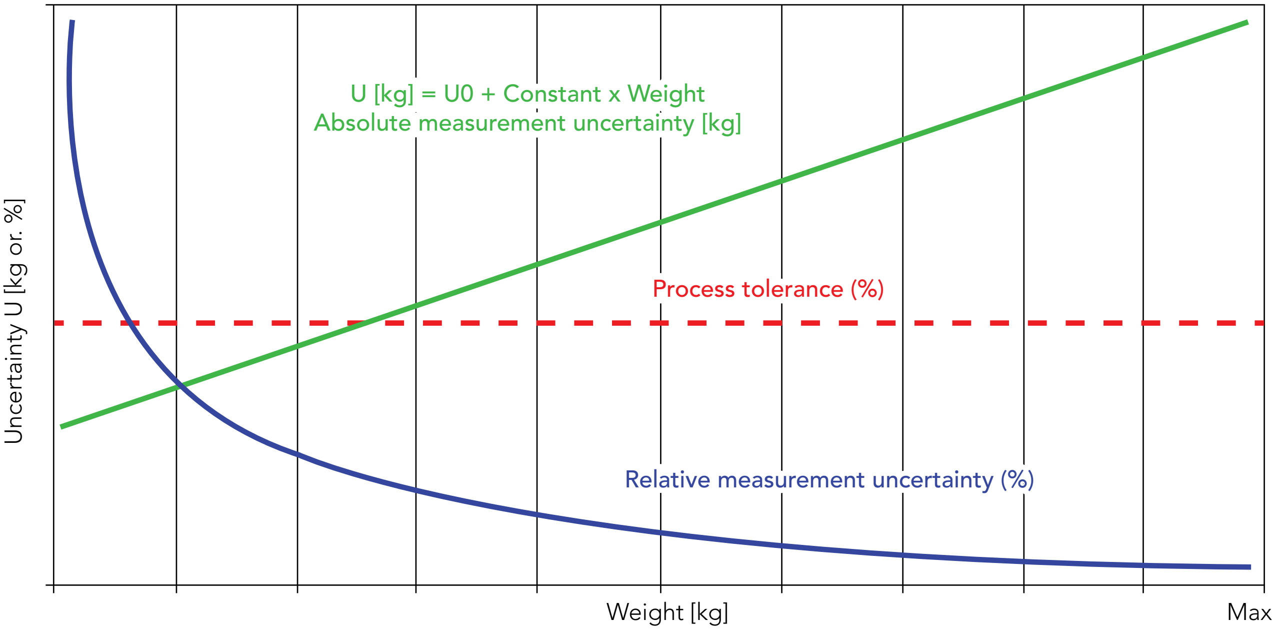

Figure 1. Relative uncertainty increases dramatically as the weight measured decreases.

IMPACTS OF UNCERTAINTY

The accuracy of a scale directly affects the quality of the final product. Using the correct scale for the application and maintaining it properly will ensure a product's quality.

The GWP methodology provides the necessary information to make decisions about your weighing system. First, when considering a new scale application GWP will identify the suitable scale (or scales) based on the items being measured and the required accuracy.

Second, GWP considers the suitability of the scale installed in the actual application and environment. By testing the scale in place, the weighing process is certified to meet the final product quality requirements and the scales are proven to be fit for their intended use. Verification will also identify weighing installations that may not be suited for the particular application and could affect quality.

Finally, testing in place will determine the proper maintenance schedule for the weighing application to help ensure the accuracy of the scale throughout its lifetime. Following this evaluation, it's common to find scales being maintained more often than necessary. The result is extra downtime and cost that isn't needed to ensure accuracy. In other situations, scales are being under-maintained resulting in questionable results over time.

The scale is a key component in many operations. Be sure that you have the correct weighing system for your application and the best maintenance schedule to ensure a long life of accurate results.

STEVEN WISE is Segment Market Manager for Mettler-Toledo. He can be reached at Steve.Wise@mt.com.