Benefits of closed system dispensing for bulk chemical applications: 7 industry profiles

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Liquid chemicals are used everywhere today, and many of these costly and often dangerous fluids are packaged and transported in drums, jerricans and IBCs for delivery from the manufacturer to distributors or end users. How to transfer these chemicals from their bulk containers to process equipment or other vessels — safely, economically and sustainably — is the subject of this white paper.

The common open-system method of dispensing chemicals from bulk containers can be fraught with complications and even danger to people, processes and the environment. Spills caused by operator error or malfunctioning equipment can create slip-and-fall hazards and risk exposing workers to contact with hazardous chemicals. Fumes that escape poorly sealed bulk chemical containers during dispensing and change out can irritate or sicken workers. In addition to safety issues, the chemicals themselves may need protecting from contamination or oxidation during dispensing, particularly when the application requires purity, the media is highly valuable or it spoils due to contact with air.

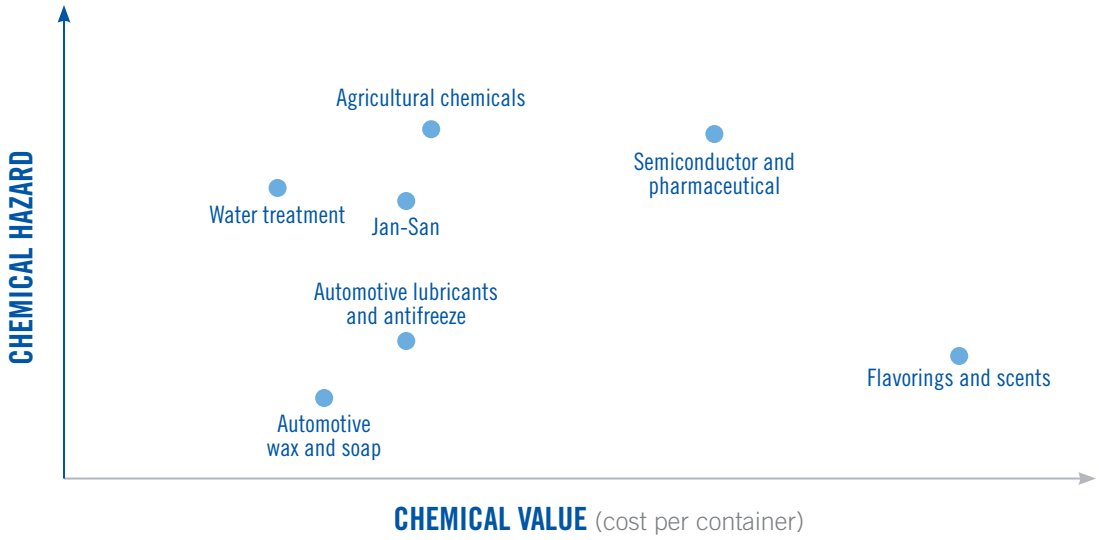
STANDARDS COMPLIANCE

In addition to safety and economic concerns, many chemical dispensing applications also need to consider industry or government rules or guidelines. Regulating bodies such as the EPA, DOT, UN, FDA, NSF, OSHA and others often impact how chemicals are transported, stored and dispensed, as do industry standards that may require the use of animal-free materials and/or sustainable practices.

OSHA addresses the management of highly hazardous chemicals (HHCs) in its guidelines for Process Safety Management (PSM). A performance-oriented standard, PSM is designed to protect workers and the workplace when a threshold quantity (TQ) of highly hazardous chemicals exists within an area under the control of an employer. Chemical dispensing — of industrial organics and inorganics as well as pharmaceuticals — is an activity that falls within this definition. For example, the chlorine used in potable water dosing applications has a TQ of 1500 pounds, making this application subject to PSM requirements for technologies and operating procedures that aid companies in complying with PSM guidelines.[1]

One way to mitigate both safety concerns and potential economic losses is to implement a closed (sealed) system for dispensing hazardous or costly chemicals. There are hundreds or even thousands of different bulk chemical dispensing applications, and each brings its own set of considerations when it comes to the rationale for closed system dispensing. (See Figure 1 on page 2.)

A closed dispensing system, by virtue of its design, offers more value as safety concerns and cost per container increase. The chart to the right illustrates the potential contribution of closed system dispensing to applications in each of the industries profiled in this paper.



To get a better handle on applying closed system dispensing for specific applications, the following profiles discuss dispensing considerations and goals in seven different industries and show how a closed dispensing system addresses both general and unique application considerations.

PROFILE 1: JANITORIAL/SANITARY/CAR WASH

Chemical dispensing in "jan-san" and car washing applications typically consists of transferring laundry soaps, bleaches, softeners, waxes and other janitorial or wash chemicals from drums to pump stations and then into equipment. Acid- and chlorine-based sterilants, sodium hypochlorite, surfactant-based media and a variety of other chemicals containing irritants are common to jan-san applications. Long-term exposure to fumes generated by these chemicals can lead to chemical pneumonitis and COPD, resulting in serious health concerns for workers.[2] Spills of cleaning chemicals are a too-common cause of slip-and-fall accidents for workers and other building occupants. Consequently, the major dispensing goals in jan-san and washing applications are to reduce messes, fumes and wasted chemicals.

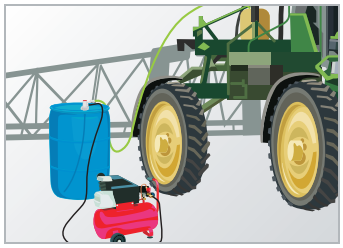
PROFILE 2: SEMICONDUCTOR, PHOTOVOLTAIC/SOLAR, FLAT PANEL, LCD

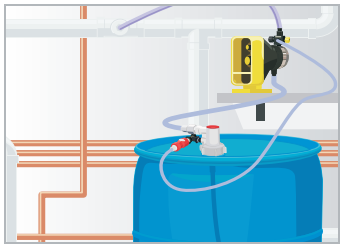
The semiconductor, photovoltaic, flat panel and LCD industries use many highly aggressive media during the various "wet" processing steps to produce the electronic devices used around the world. Ammonium hydroxide, NMP, TMAH, sulfuric acid, nitric acid, hydrofluoric acid and photoresists are a few of the chemicals used in the wet chemistry process. It is critical when transferring these high-purity, high-cost chemicals from drums and IBC totes to maintain purity and avoid cross contamination and oxidation when dispensing. Therefore, the dispensing goals for semiconductor and related applications are to protect chemicals and process from contamination (particularly contamination by metals, particles and lubricants), prevent oxidation by applying a nitrogen blanket gas and protect personnel from dangerous media.

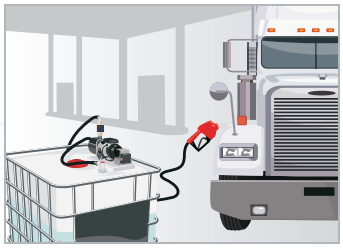
PROFILE 3: PHARMACEUTICAL

The production of pharmaceutical-grade compounds requires the transfer of often costly sometimes-dangerous media from drums and IBC totes to process equipment. Surfactants, such as ammonium sulfate, glycerin and polysorbate; aqueous solutions, such as acetic

A wide array of commercial applications can benefit from a closed system for dispensing bulk chemicals, including the seven profiles discussed in this paper.







acid, hydrochloric acid and sodium hydroxide; and solvents containing butanol, chloroform and methanol are common to the industry, as are the CIP (Clean In Place) sterilants used to clean equipment. The slightest contamination during production can ruin costly media during the growth of cultures. In these applications, it is critical to use materials that are FDA compliant, Animal Free or USP Class VI and manufactured in clean room environments. As a result, cost and contamination are the two biggest concerns in dispensing pharmaceutical chemicals. The dispensing goals for pharmaceutical applications are to protect chemicals and processes from contamination that can ruin test or production cultures and to protect personnel from exposure to dangerous fluids and fumes.

PROFILE 4: WATER TREATMENT DOSING

Waste water treatment and similar processing applications often involve the dosing of very small (< 1 gph) amounts of chemicals to reduce or eliminate algae, to disinfect and neutralize effluent to improve water quality or to prevent corrosion. The chemicals used in these dosing applications include copper sulfate and iron salts in algaecides; chlorine dioxide in disinfectants; sodium hydroxide and calcium carbonate and diluted sulfuric and hydrochloric acids for controlling pH levels in neutralizing agents; and natrium hydroxide to prevent corrosion in municipal water supplies.[3] It is essential to prevent worker contact with these noxious chemicals when transferring the fluids to dosing equipment, making the protection of personnel this industry's No. 1 dispensing goal.

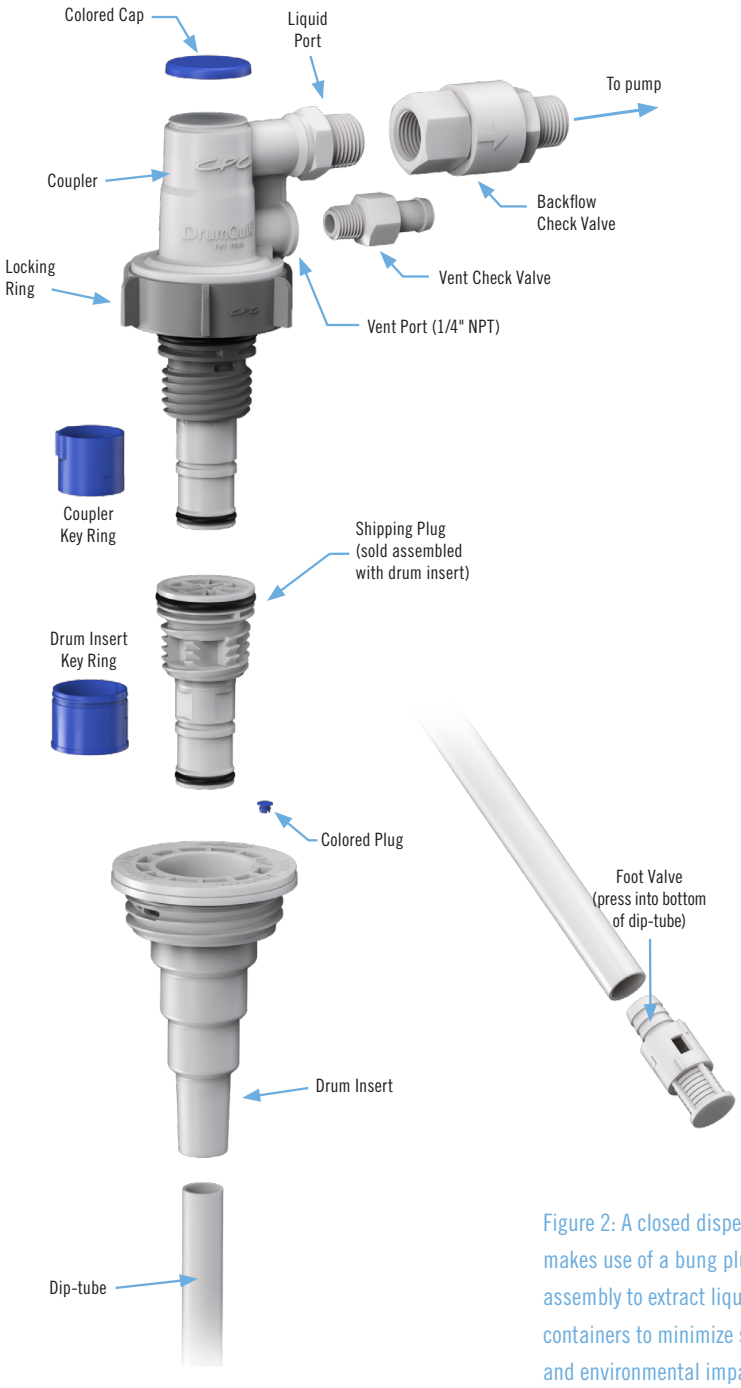


Figure 2: A closed dispensing system makes use of a bung plug with dip-tube assembly to extract liquids from rigid containers to minimize spills, fumes and environmental impact.

PROFILE 5: AUTOMOTIVE FLUID

Transferring diesel exhaust fluid (DEF/AdBlue), washer fluids, anti-freezes, wax, soaps and lubricants from drums in service centers and car washes are common dispensing applications related to automotive fluids. Although automotive fluids are typically less hazardous and costly compared to the chemicals used in semiconductor, pharmaceutical and water treatment industries, spills in these work settings can create safety hazards that lead to slips and falls and unpleasant odors in the atmosphere. The dispensing goals, therefore, are to protect workers and other building occupants from injury and employers/building owners from liability exposure.

Figure 3: For special applications, a 3-port adaptor allows simultaneous chemical extraction, venting/ application of a blanket gas and recirculation.

PROFILE 6: AGRICULTURE

The use of chemicals in agriculture has greatly expanded food production, but at the same time, the use of these chemicals is an ongoing health and environmental concern. Fertilizers, insecticides, fungicides, rodenticides and herbicides, among others, are typical chemicals found in agriculture applications. Transferring these chemicals from jerricans, drums and IBCs to agriculture equipment can pose risks to workers due to contact or fumes and risks to the environment if unintended quantities are spilled. Implementing a dispensing system that addresses these worker and environmental hazards is a primary concern in agricultural applications.

PROFILE 7: FLAVORINGS AND SCENTS

The flavorings and scents used in the production of food, beauty products, household products and many other items usually consist of high-value chemicals and edible oils, flavorings and other media requiring the use of FDA compliant materials. These substances are typically transferred from drums and IBC totes to mixing vessels in the production of items as varied as coffee beans, e-cigarettes, perfumes and plug-in air fresheners. Due to the high costs of these chemicals (upwards of $1,000+ per container), it is important for producers to avoid oxidation through the use of a nitrogen blanket gas, contain fumes and extract as much chemical as possible when dispensing from shipping containers to mixing vessels in order to maximize production and prevent wasted product. Maintaining the purity of the chemicals is also a major concern for producers. Because the end products will be used and even consumed by humans, the purity of chemicals cannot be compromised. Many applications involving flavorings and scents prohibit the introduction of animal byproducts, making animal-free dispensing materials essential for achieving these applications' goals.

HOW CLOSED SYSTEM DISPENSING ADDRESSES GENERAL AND UNIQUE APPLICATION CONSIDERATIONS

A closed dispensing system is meant to minimize application concerns of chemical exposure and contamination during transport, dispensing and disposal. Such systems usually consist of a reusable coupler/dispense head that connects to an integrated bung plug with dip-tube assembly. (See Figure 2.) The coupler should have a ported vent system for vapor management that allows make-up air or a nitrogen blanket gas into the drum or tote to replace the liquid being removed as well as an automatic shutoff valve that stops flow upon disconnection to prevent spills. The dip-tube system seals and travels with the container to the end user site. Once there, the coupler connects to the dip-tube assembly for dispensing. This makes it an ideal system for meeting some of the general dispensing goals in all of the preceding applications.

A closed dispensing system addresses unique application concerns, as well.

- In high purity applications where contamination is a major application consideration, a closed system featuring cleanroom-manufactured components helps assure that contaminants are not introduced in the system's manufacture. Some dispensing equipment manufacturers also produce closed system components that meet FDA and animal-free specifications, thereby reducing even further the risk of contaminants prohibited by industry or government regulations in applications where end products will be used or consumed by humans.

- Many applications utilize unusual dispensing container styles, such as those with Nalgene® bottle caps. In these applications, it is advantageous if an option for a universal adaptor is available. The DrumQuik system from CPC, for instance, offers a 3-port universal dispensing adaptor (Figure 3). The adaptor features ¾" male NPT threads that mate with common containers bung, plugs and caps, allowing simultaneous chemical extraction, venting/ application of a blanket gas and recirculation

— if needed.

CONCLUSION

A wide range of industries deals with the transport and mixing of hazardous and/or valuable chemicals, and closed systems dispensing can offer safety and other benefits for chemical handling, processing and shipping applications. Many manufacturers are routinely audited by the EPA, FDA and local governments to ensure their work environments are free of harmful pollutants. Integrating a bung plug with dip-tube assembly and a sealed coupler/dispense head can help establish a level of security within an operation, maintain a safe work environment for employees, and help provide superior contaminant-free products for customers.

About CPC

CPC is the leading provider of quick disconnect couplings and fittings for life sciences, industrial and chemical handling markets. CPC's wide range of chemically resistant quick disconnect couplings and DrumQuik® closed chemical dispensing systems provide non-spill operation and improve employee and environmental safety in chemical management environments. Applications include water treatment, janitorial and sanitation, Diesel Exhaust Fluid (DEF) dispensing, semiconductor and pharmaceutical manufacturing as well as pump, filter and Vde-ionized water connections.

DrumQuik PRO systems create a closed transfer system for general chemicals. Rugged and cost-effective DrumQuik dispensing systems minimize chemical exposure and facilitate the delivery of chemicals from bulk transfer containers to end use applications. For high purity applications, DrumQuik PUR provides the assurance of chemical compatibility and cleanroom assembly for contamination prevention

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