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How to Boost Profits with Single-Use Powder Transfer

IN BIOPHARMACEUTICALS MANUFACTURING

OVERVIEW

Many biopharmaceutical manufacturers are implementing single-use containment and transfer of media and buffer materials to prevent feedstock contamination and promote worker safety. Choosing the proper containment system can have a significant impact on productivity and profitability.

CONTAINMENT AND TRANSFER SYSTEMS SHOULD BE EASY TO FILL AND FAST TO DISPENSE.

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CRUCIAL QUESTIONS

Systems should be analyzed not only for their basic ability to contain the powders of interest, but also for how efficiently they integrate into the production process.

For instance, will the system help to eliminate productivity bottlenecks, decrease material waste and the cost of raw materials and simplify the changeover of the line to new products? Is it robust enough to provide reliable transfer throughout the production run? And has it been designed from the ground up specifically to contain and release powders?

Being able to answer these questions affirmatively is crucial to implementing a sound containment system.

ISSUES OF POWDER HANDLING

For many years, media and buffer ingredients used in powder form were transferred from stock containers using open scoops, weighed and mixed in buckets or open-top bags, and then carried in and dumped from those buckets or open-top bags directly into production vessels — based on the premise that sterility wasn't required at that early stage of manufacturing. While much of this process was often carried out in a separate room from the production line to contain airborne contaminants, final transfer to the production line still had to occur.

In recent years, manufacturers have recognized that, while sterility may not be an issue, worker exposure to airborne particulates and the potential for cross-contamination when changing the line over to different products are certainly concerns.

Consequently, biopharmaceutical manufacturers have started to implement single-use systems for powder transfer. Unfortunately, many early systems were simply adapted to handle powders from liquid-handling systems already in use at the time. These systems often have inherent design shortcomings.

THE KEYS TO EFFICIENT POWDER TRANSFER AND CONTAINMENT

The most efficient powder containment and transfer equipment will exhibit a number of specific characteristics, including:

- A design developed specifically to handle powders
- Fast filling
- Easy, complete sealing
- Fast, clean dispensing
- Complete product recovery (i.e., no powder left in the container)
- Self-supporting containers to promote easy handling and distribution

Just as important as the system's performance characteristics are the attributes of the system supplier.

- Are they responsive and adaptable to all of your manufacturing processes and procedures?
- Do they have the necessary regulatory approvals for their equipment and containment materials?
- Are they supported by a long history of service to the industry and a dedication to strong customer support?
- Do they offer expert consultation during system development?

EVALUATING POTENTIAL SYSTEMS

The simplest approach to evaluating powder containment and transfer systems is to proceed step-by-step through the criteria listed above for determining system applicability and efficiency.

GENESIS OF THE DESIGN

The first question to ask any supplier is whether their powder-handling system was specifically designed for that application or was, in fact, adapted from an existing liquid-handling system.

While powders and liquids do behave similarly under some conditions, their flow and handling characteristics are not the same. Differences arise in required dispensing volumes, flow rates and the most efficient cross-sectional area of the filling and dispensing openings, among other things.

Static buildup in the containment material also plays a different role in powder handling than in liquid handling.

ILC Dover's EZ BioPac® system, for instance, was designed by DoverPac® Containment Systems engineers from scratch, specifically for powder handling in the biopharmaceutical industry. Their focus from the beginning was to get the usability of the system just right. Furthermore, the EZ BioPac system is a true three-dimensional design, allowing for enhanced flow and control of the powder, unlike its two-dimensional competitors.

THE NARROW OPENING USED WITH MANY LIQUID-DERIVED CONTAINERS CAN MAKE THEM DIFFICULT TO FILL.

WIDE OPENINGS AND A PROTECTIVE OUTER SKIRT MAKE ILC DOVER'S EZ BIOPAC® CONTAINERS EASY TO FILL, EASY TO SEAL CLEANLY AND EASY TO HANDLE DURING TRANSPORT.

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FILLING EASE

The narrow openings in many of the packs derived from liquid-handling systems can make filling slow and difficult, while increasing the risk of spillage, which can lead to contamination of the pack surfaces as well as wasted raw materials. In addition, even during careful filling, particles hitting the funnel's hard surface can bounce out of the funnel, contaminating the bag and its support stand.

ILC Dover has designed its EZ BioPac vessels with a large-diameter, open-funnel top for easier and quicker filling. The pack fits into a light, nonmetallic frame that holds the top open, so the need for a separate funnel is eliminated, along with the need to clean it.

By reducing uncontrolled powder handling, the EZ BioPac system lessens the amount of powder that disperses into the air, thereby lowering the risk of cross-contamination and perhaps reducing cleaning frequency.

Lower powder dispersal also serves to reduce staff exposure to inhaled particulates, while reducing ignition risk.

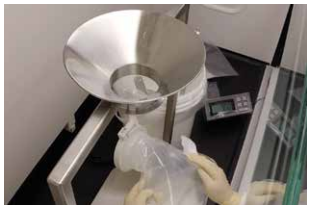
FILL ADJUSTMENT

The large fill opening of the EZ BioPac bag also reduces the chance of overfilling and makes it easier to fine-tune the weight of product. If the operator overshoots the target weight, he or she has only to reach in and easily scoop out the overage until the weight is exact.

With narrow-neck bags, fine-tuning the final weight is awkward, requiring use of a narrow ladle and cumbersome manipulation of the filled bag.

THE EZ BIOPAC® CONTAINER'S WIDE OPENING MAKES IT EASY FOR THE OPERATOR TO FINE-TUNE THE FINAL WEIGHT.

OPERATOR LIFTS NARROW-NECK BAG TO REMOVE POWDER WITH SMALL LADLE TO FINE-TUNE WEIGHT.



BOTH THE BAG AND STAND USED WITH NARROW-NECK BAGS REQUIRE WIPE-DOWN AFTER FILLING.

FILL SPEED

In trials designed to test the filling efficiency of ILC Dover's EZ BioPac system, the larger opening, and the design of the fill opening and skirt proved to offer filling performance superior to other, narrower-opening designs.

For instance, to measure its specific performance, ILC Dover tested its EZ BioPac system against a typical competitive 2D transfer bag.

The test procedure required filling each bag to approximately 5.25 kg, then adjusting the final weight consistently to an endpoint value of 5.0 kg.

The EZ BioPac system yielded a 71.1% faster total fill time, averaged over three independent trials.

CONTAMINATION POTENTIAL

During filling, many types of single-use bags can become contaminated on the outside surface when product is spilled or overflows, or when it simply settles out from the surrounding air. The separate support stand can also become contaminated during bag removal. Both the bag and stand, therefore, require wipe-down after filling, to avoid cross-contamination.

To avoid this requirement, ILC Dover's EZ BioPac system includes a protective outer skirt (see photo on page 4) that folds down to completely cover the outside of the bag and the support stand during filling. After filling, this skirt is simply turned up to its original position and sealed, locking any powder residue on its interior surface.

The potential for surface contamination is thereby drastically reduced, and sealing and handling are much easier and cleaner.

FILLING TRIALS — TIME TO FILL TO 5.0 KG

		EZ BIOPAC®	2D TRANSFER BAG
TEST #	TEST MEDIA	PROCESS FILL TIME (min:sec)	PROCESS FILL TIME (min:sec)
Run #1	Magnesium Sulfate	2:03.91	3:09.21
Run #2	Magnesium Sulfate	1:54.66	3:01.06
Run #3	Magnesium Sulfate	1:37.07	3:24.13

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SEALING ILC DOVER'S EZ BIOPAC® IS A SIMPLE, QUICK, ONE-PERSON OPERATION.

SEALING SPEED AND SIMPLICITY

The EZ BioPac is simple to seal by one of two methods. The first requires making a Z-fold in the bag's upper neck and then clamping the fold tightly closed with attached cable ties. The second (shown) uses ILC Dover's proprietary robust crimping system, which allows quick, one-person sealing under virtually any conditions.

Competitive bags require placing a cap over the opening, then holding it in place while putting a split-ring clamp in position over the cap and tightening it in place. The cap can easily slip out of position during this process, requiring repeated attempts to properly align the cap and clamp before the clamp can be tightened to seal the bag.

DISCHARGE EASE AND SPEED

Just as filling containment packs must be done as accurately and repeatably as possible, discharging them must provide for complete powder transfer to the mixing vessels.

While the bags in many systems must be discharged through the same narrow neck used for filling, the EZ BioPac system's bags feature a discharge outlet completely separate from the fill inlet. With this configuration, the discharge flow path remains clean and untouched by powder until transfer is initiated. Again, comparison trials show the superiority of this design approach.

ILC Dover tested its EZ BioPac bag against a competitive 2D transfer bag in head-to-head time trials.

Test procedure

Remove clamp (if required), install bag, open closure, discharge contents, fasten closure.

Results

EZ BioPac yielded an **18.6% faster total discharge time**, with 33.3% less product retention, averaged over three independent trials.

DISCHARGE — RETENTION

ILC DOVER RECOVERY TEST	TEST MATERIAL	EZ BIOPAC® RETENTION, g	2D BAG RETENTION, g
Trial 1	Flour	2	3
Trial 2	Flour	2	2
Trial 3	Flour	2	3

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THE COST OF STATIC AND BAG GEOMETRY

The two primary sources of incomplete discharge and product waste for many 2D single-use bags are bag geometry and the static that can build up on the film. The 2D bag's pinch seams create narrow channels where powder can become trapped, while static can cause particles to cling to the inside of the bag's surface, regardless of the degree of shaking or agitation of the bag.

To counter this problem, the EZ BioPac 3D containment packs provide a round, smooth discharge path and are fabricated from ILC Dover's proprietary ArmorFlex® 114 antistatic film, which meets FDA, USP and EU regulatory compliance standards. With little or no static charge, the EZ BioPac releases its contents much more completely, reducing ingredient waste and making batch-to-batch product more consistent.

Comparative testing demonstrates a 33.3% improvement in recovery rates offered by the EZ BioPac bag geometry, when measured against a 2D bag made from ILC's own ArmorFlex 114.

DISCHARGE TRIALS — TIME TO DISCHARGE 5.0 KG

ILC DOVER DISCHARGE TEST	TEST MATERIAL	TEST DISCHARGE RATE, SAMPLE #1	TEST DISCHARGE RATE, SAMPLE #2
Trial 1	Flour	1:49.0	1:45.0
Trial 2	Flour	1:51.81	2:03.07
Trial 3	Flour	1:21.42	2:10.70

ERGONOMIC DESIGN

Some manufacturing processes require large quantities of buffer and media, readily available in a number of locations. Because the filled EZ BioPac 3D containment pack is self-supporting, it can be filled in a central location, then moved easily and staged in appropriate locations, as required by the process.

Standard sizes are available in a range from 1 liter to 100 liters, and custom sizes are available. They include built-in handles or lifting loops, depending on the size, and are made from heavy-gauge materials to support the weight of product with which they're filled.

FULL RANGE OF BAG VOLUMES AND FLANGE SIZES

Successfully converting a plant to a single-use powder transfer and containment system requires bags be available for a full range of volumes and flange sizes, so ILC Dover makes EZ BioPac bags in sizes ranging from 1 to 100 liters and flange sizes from 1.5" to 8".

SANITARY FLANGE SIZES AVAILABLE

EZ BIOPAC® VOLUME, L	1.5"	2"	3"	4"	DN 100	DN 150	6"	8"
1	✔	✔	✔	✔				
5	✔	✔	✔	✔				
10	✔	✔	✔	✔	✔			
25		✔	✔	✔	✔	✔	✔	✔
50					✔	✔	✔	✔
100						✔	✔	✔

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SUMMARY AND CONCLUSION

Handling any powder disperses fine particles into the air. While the ingredients used in media and buffer preparation are typically benign and stable, long-term exposure can cause harm. With even the most stable of compounds, a fine powder "haze" in the air can also create some risk of ignition. In addition, airborne particles eventually settle out onto surfaces, posing a risk of cross-contamination and requiring cleaning.

Solutions such as the EZ BioPac system from ILC Dover lessen the amount of powder that disperses into the air substantially, thereby lowering the risk of cross-contamination. Reducing the amount of contamination, in turn, reduces the time needed for changeover, lowers staff costs and frees staff to work on more vital jobs — which all contribute to profitability.

A LOOK AT THE FUTURE

While media and buffer materials have been notorious contributors to airborne particulates and contamination in the past, they don't have to be. With careful evaluation and system specification, new, dedicated powder transfer systems like EZ BioPac can help eliminate those issues in closed processes.

For more information on products and services, email **customer_service@ilcdover.com**, or call +1.302.335.3911 or toll-free +1.800.631.9567 (US & CAN).

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Innovators at our core, we develop engineered solutions for our customers' complex problems. Recognized globally for our flexible containment solutions, ILC Dover serves customers in a diverse range of industries, including pharmaceutical and biopharmaceutical manufacturing, personal care, food and beverage, chemical, aerospace, healthcare and government agencies. At ILC Dover, quality is a culture, not a measurement. Our customers will tell you that we cater to their every need and that we're highly innovative, responsive, dedicated and competitive. We have been innovating since 1947. ILC Dover's visionary solutions improve efficiency, safeguard workers and product, and prevent disasters — proof that we are on the front line of business excellence.

Engineering evolution beyond boundaries.

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