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Onward and upward for SUS in bioprocessing

Addressing challenges in the single-use system market requires collaboration

Single-use systems (SUS) are now used for about 85 percent of precommercial scale (preclinical and clinical) biopharmaceutical manufacturing and increasingly for commercial products manufacturing. This shift from fixed stainless steel appears to be revolutionizing the therapeutics market.

While large-scale, fixed stainless steel equipment-based facilities continue producing biopharmaceuticals, the market for SUS, composed primarily of plastic components that are sealed and sterilized using gamma irradiation, continues its rapid ascent. According to Grand View Research, in 2019, the global SUS market was valued at $12.6 billion, with a 12.8 percent compound annual growth rate forecast through 2027, when it will top $33 billion.

Lower energy and direct-labor costs, plus faster changeover times are important SUS drivers. Like any major change, the SUS shift brings with it challenges as pharma manufacturers turn to their suppliers to provide assurance that their products deploy operational best practices and are certifiably safe.

To address key challenges in the SUS market and meet the product development needs of the pharma industry, collaboration is needed between pharma companies, system suppliers and components suppliers.

Meeting demands

One such effort comes in the form of the BioPhorum Operations Group, a global collaboration comprising more than 90 biopharma companies and suppliers; its purpose is to develop and share best practices for pharma manufacturing. For example, BioPhorum has succeeded in establishing effective testing methods for extractables and leachables to help the industry approve SUS for safe and effective use.

To select processing materials that avoid risk, it's important to understand the chemical nature of extractables — compounds emitted from a packaging component, delivery system or manufacturing surface during aggressive testing, and leachables — compounds that migrate into the drug over time from contact with the system componentry and manufacturing surfaces.

To assist suppliers with their evaluation of SUS extractables, the BioPhorum team developed testing protocols based on a set of solvents and immersion times. Adhering to such protocols helps ensure the successful use of SUS for biopharma manufacturing, though the final responsibility for confirming the safety and efficacy of the therapeutic remains that of the pharma companies, not their suppliers.

Best practice guidelines

Independent industry surveys have shown that concerns about extractables and leachables are the number one barrier to implementing disposables technologies. There is clear guidance around what is required by regulatory authorities such as the U.S. Food and Drug Administration (FDA) and the European Medicines Agency (EMA), yet to date there has been limited or no information (consensus or best practice) on how companies should execute.

To close this gap, complementing the BioPhorum extractables protocol is a best practice guide for evaluating SUS leachables. BioPhorum protocol applies to SUS components that contact the pharma product or process fluids, including but not limited to:

Advancements in therapeutics will continue driving the development and growth of SUS and their components.

Like any major change, the SUS shift brings with it challenges as pharma manufacturers turn to their suppliers to provide assurance.

- Tubing, tubing connectors and disconnectors
- Bags and films used for storage, mixing, or as bioreactors
- Aseptic connectors and disconnectors
- Sterilizing-grade and process filters
- Tangential flow filtration cassettes
- Sensors
- Valves
- Elastomeric parts (gaskets, O-Rings, diaphragms, and septum)
- Wetted polymeric surfaces of positive displacement pumps
- Chromatography columns
- Molded parts of mixers
- Filling needles

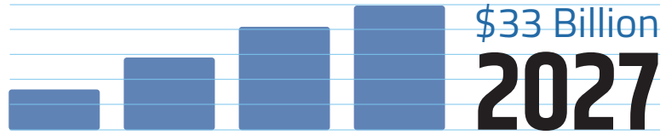
The guide is also intended to aid in study design to assess polymeric SUS components, using appropriate analytical methodologies for detection of potentially leachable compounds. The methodology is designed to be robust and yet sufficiently flexible to be adapted to each company's needs.

Making the grade

Achieving medical-grade status with system components requires treating the part as a medical product when it comes to cleanroom and manufacturing practices. For tubing, for example, it's no longer acceptable to manufacture product on the production floor and then attempt to sterilize it. Tubing production must take place in ISO Certified cleanrooms that adhere to the FDA's Current Good Manufacturing Practices governing particulates, air pressure and personnel practices to ensure that products meet tolerance and cleanliness requirements. This may require bioburden and endotoxin testing.

These procedures help ensure safe, validated products in critical areas such as the transfer of monoclonal antibodies — laboratory-produced base media for therapeutics engineered to represent the body's immune's system and used in the development of cancer-treating therapeutics. The tubing must be bacteria-free and remain strong as it transfers the monoclonal antibodies to the bioreactor and chromatography equipment, where wanted therapeutics are filtered out.

Other single-use tubing applications include peristaltic pumps with rotating wheels that push the fluid through tubes. To withstand the rigors of the pumping process and ensure that the tubing walls remain intact, high-strength tubing is required.



The global single-use bioprocessing market is expected to reach $33B by 2027

GRAND VIEW RESEARCH

Looking ahead

Advancements in therapeutics will continue driving the development and growth of SUS and their components.

One such advancement — chimeric antigen receptor (CAR T) cell therapy —taps into the potential of personalized medicine for cancer treatments, using the patient's immune system to target and attack tumors. Currently, three FDA approved CAR T cell therapies, developed by Gilead and Novartis, are available.

Investigational for now, the safety and efficacy of T-cell therapy is an active area of research, and it could prove to be a game-changer. A cancer patient's blood is collected and purified to select the T-cells, which are activated and expanded within the lab and transfected to express a chimeric antigen receptor, or synthetic T-cell receptor, targeting a specific tumor antigen. The T-cells grow and expand for two weeks and are then infused back into the patient where the engineered cells attack the tumors.

However, this chain of events requires a precise timeline with all components of the process being sterile and having passed stringent testing for quality and reliability.

Unlocking the immune system to effectively fight cancer is truly exciting — and serves as a great illustration of the potential use of SUS in biopharmaceutical processing.