Reconsidering Impact: Single-Use Vs. Stainless-Steel Systems

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It's not uncommon today to believe disposable system components are always more environmentally harmful than reusable equipment; however, in the past 10+ years, research has shown that this is not necessarily the case. There is a key global initiative to reduce the negative impact of human activities on the environment, and for pharma and biopharma manufacturing, pollution mitigation is a predominant imperative. To apply the fastest and most effective pollution-reducing recommendations to the industry, it is vital to first identify biochemical manufacturing's key pollution contributing factors:

Approximately 25–100 kilograms of waste is generated per kilogram of product by the pharmaceutical industry[1]

Manufacturing is 32% of all energy consumption in the US — the chemical industry is 8%[2]

Building space on average contributes to 9GT CO2 per emissions per year[3]

When we look holistically at reducing the net negative impact on the environment caused by the biopharmaceutical manufacturing process, single-use plastics are a viable and efficient option ultimately mitigating impact through reduced water usage, energy consumption, and space utilization.

Water makes up about 71% of the earth's surface and only about 3% of that is considered fresh water with 2.6% of that fresh water inaccessibly locked in glaciers. Manufacturing accounts for 25% of global freshwater withdrawals and demand is increasing year over year. Chemical pollution by manufacturing facilities has a large negative environmental impact, and it's no surprise that this is a critical area for improvement. Traditional systems require many additional chemicals and water to keep clean. Adopting single-use systems has been found to reduce water usage by around 87%. By implementing single-use systems over traditional systems, manufacturers can significantly reduce their overall water consumption and associated pollution.

Since the advancements made over 150 years ago by the Industrial Revolution, the world is increasingly reliant on electricity, 80% of which is powered by fossil fuels. The global industrial sector consumes about 54% of the world's total delivered energy and the total consumed is rising year over year across the board. Replacing stainless-steel receptacles with disposable alternatives has shown that the total electricity consumption can, on average, be reduced by 30%. In a monoclonal antibody facility, the ratio of energy expenditure during the traditional reusable-container production process is spread across cell culture and solution

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8479785/
[2] https://esource.bizenergyadvisor.com/article/manufacturing-facilities
[3] https://www.iea.org/data-and-statistics/charts/global-co2-emissions-from-building-operations-in-the-net-zero-scenario-2010-2030
[4] https://worldwaterreserve.com/percentage-of-drinkable-water-on-earth/

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preparation operations as well as the downstream process. When the facility switches to pre-sterilized disposable receptacles, the overall electricity usage decreases and the ratio of energy expenditure concentrates on the downstream process. As a manufacturer, it is also important to note that there are increasing global restrictions on carbon output; but just as beneficially, there are incentives for carbon neutrality. Lowering the overall carbon output as well as implementing alternative energy sources will position manufacturers to stay compliant and in return receive financial incentives. It's clear that the manufacturing sector is responsible for much of the total global energy expenditure, and the initiative to reduce this reliance and expense associated with that consumption can be exercised by switching to single-use plastics.

The spatial considerations for disposable systems versus traditional systems can vary depending on the type and scale of the facility. It is important to note that larger-scale operations may gain more advantages from using a traditional system. In comparison smaller-scale operations that have a high turnover, more variability, and smaller batch sizes might garner more advantages from single-use systems. With all things considered, studies show that the average spatial requirements for a biomanufacturing facility can be reduced by as much as 38% by switching to single-use systems. A big component of this is not requiring space to clean the reusable stainless steel.

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The utilized space impacts the overall energy use of the facility because the HVAC system is one of the biggest contributors to energy expenditure and has a direct correlation to facility size. Manufacturers who decide to design new facilities should keep this in mind as the disposable systems can help reduce and optimize the required space. Developers who investigate redesigning existing facilities have the potential to optimize their space using single-use plastics and may be able to produce a greater output per facility. Efficiently using space can not only potentially increase output per square foot but also reduce the overall environmental impact of current and future facilities.

[5] https://www.fluencecorp.com/manufacturing-water-use/
[6] https://www.iqpc.com/media/7763/11363.pdf
[7] https://www.eesi.org/topics/fossil-fuels/description
[8] https://www.eia.gov/outlooks/ieo/pdf/industrial.pdf

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Environmental-based initiatives within the manufacturing realm are crucial objectives considering the limited resources available globally

There are a wide range of considerations to examine when a manufacturer is looking to operate more sustainably. Assessing single-use versus reusable stainless-steel systems is certainly a crucial consideration, but changes made beyond the scope of manufacturing itself and focusing on logistics could reduce carbon emissions even further. Location is often an overlooked element in the sustainability discussion. A worker's commute to the facility is typically the largest contributor to carbon emissions and the facility's location helps determine

which alternative energy resources can be optimized. Closely monitoring waste management includes applying the pros and cons of incineration versus landfill versus recycling, assessing operational output, and scaling in accordance with cleaning and energy efficiency needs. Consistently ensuring logistics and processes are up to date with the most capable operational design and execution can create a positive funneling impact. As a rapidly growing industry, biopharmaceutical manufacturing is called to prioritize these points to balance growth, sustainability, and efficiency.

Environmental-based initiatives within the manufacturing realm are crucial objectives considering the limited resources available globally. As aforementioned, deciding what is sustainably ideal and impactful for each facility is greatly affected by the scale of the facility, location, and logistical processes. The central factor examined in this article showcases that sometimes the overall more sustainable choice is not immediately obvious. When examined from multiple angles, opting for single-use plastics can be the more environmentally friendly option for manufacturing. These findings give manufacturers more insight into an often-overlooked factor in pursuing greater sustainability.

Questions?

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