VALUE PLASTICS, INC.
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Single-Use Systems

Show Me **the Green!**

A Value Plastics White Paper

WHITE PAPER

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Single-Use Systems – **Show Me the Green!**

by Ken Davis, Global Marketing Manager, Value Plastics, Inc.

Before canvas bags became a grocery store mainstay, I cringed when asked at the checkout, "paper or plastic?" In a split second I'd weigh the environmental impact (paper bags thin forests, but they're recyclable) against convenience (I can carry 10 plastic bags at once!). I never was sure of the "right" answer.

Fast forward to today's pharmaceutical manufacturing industry and the debate about single-use disposable systems vs. traditional stainless-steel systems. Although these decisions are on a much larger scale than my grocery store conundrum, process designers and users face a similar dilemma – determining the best system that's environmentally friendly for day-to-day use.

Experts have written reams of paper about both systems that detail time savings, cost savings and more. This paper will review the environmental benefits of single-use systems, then take the environmental issue a step further by encouraging the bioprocessing industry to approach key clean-energy players, thus further boosting environmental benefits of single-use systems.

Quick Review of SUS and Traditional Stainless-steel

Single-use systems (SUS) are polymer-based components that replace reusable stainless-steel or glass components. These disposable systems can accommodate volumes up to 3,000 liters, which meets capacity requirements for most vaccine and biopharmaceutical products. Just as PVC bags have largely replaced glass bottles that store blood and blood components, SUS is rapidly replacing traditional and reusable stainless-steel or glass.

Traditional stainless-steel equipment has been used for years in bioprocessing and manufacturing plants. This equipment, which ranges from small units to an extremely large 20,000L vessel, are static systems that can be used over and over. A need for stainless-steel equipment always will exist, since these components are useful for enormous volumes or highly specific applications.

Why SUS is Smart

About a decade ago, the debate about SUS vs. traditional stainless-steel was just a whisper: reusable stainless-steel was favored because it was the system that process designers and users had relied on for years. Then awareness of the cost savings and environmental benefits of SUS grew, and a shake up in the industry started. Pharma and biopharma companies small and large began using one-off bags, connectors and small bioreactors in their manufacturing operations. Year after year, a growing number of managers in the biopharma production chain realized the overwhelming benefits of SUS:

- *Significantly decreased risk of contamination since equipment is only used once.*
- *Greater cost savings due to less up-front investment (stainless-steel components are costly), a drastic reduction in chemical and water use, lower energy bills and reduced labor costs.*
- *Faster time to market since SUS enables faster batch process and product changes in manufacturing lines.*
- *Lower environmental impact:*
  - *Polymer-based SUS components require less water, utilities and chemicals;*
  - *Water footprint of SUS is 46% less than stainless-steel systems (Cox & Leveen, 2008);*
  - *Carbon footprint of SUS is 35% less*

SUS Energy Savings & the Environment

While it seems counterintuitive, disposable SUS components are actually far better for the environment than traditional stainless-steel. Stainless-steel requires constant cleaning and sterilization between batches, which means extremely high use of water and chemicals. Consuming and heating large volumes of water to clean and sterilize stainless-steel equipment is more energy demanding than producing and inactivating plastic bags, which also can be incinerated for energy recovery. (Guldager, 2010)

Lindsay Leveen of biotechnology company Genetech stated in American Pharmaceutical, "Cleaning of traditional facilities is a resource intensive operation, and the more one cleans the facility the more one pollutes the environment." (Leveen, October 2009). He continued, "Cleaning of a biopharmaceutical facility with steam and chemicals is a well developed science and well understood by drug manufacturers. What many do not realize is that any operation that requires the phase change of water from a liquid to a vapor is a very energy-intensive operation."

Rawlings and Pora, in their 2009 BioProcess International article titled, Environmental Impact of Single-Use and Reusable Bioprocess Systems, concluded that, "The disposable process (SUS)…gave total energy consumption values that were about half those of the traditional system." (see Figure 1)

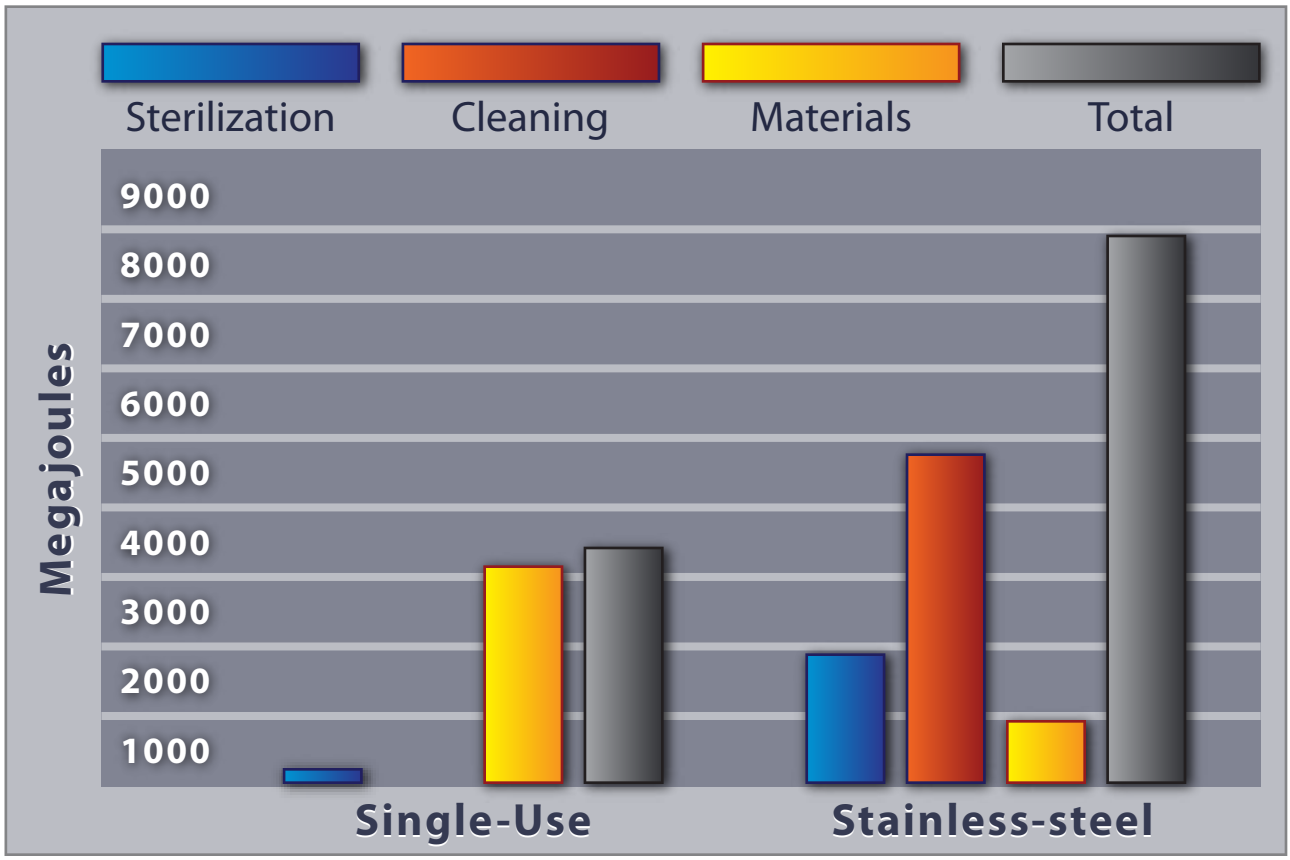

Figure 1 – Total energy consumption in megajoules (Pora & Rawlings, February 2009)

SUS Waste Can Mean Smart Energy

Once used, a single-use system component can have a second life as an energy source. While interest in SUS waste as an energy source is low today, the potential exists for rapid acceptance of the technology in coming years, especially as plant managers become aware of potential energy cost savings available, and state and federal governments broaden financial and tax incentives.

When single-use systems are incinerated, significant amounts of heat energy are produced. Rather than have the unused heat escape to the atmosphere, technologies are available today to capture the waste heat and use it to make electricity onsite for a manufacturing facility or to heat facility boilers.

Known as cogeneration or combined heat and power, these systems are common at universities, hospitals and businesses across the country. In Europe, cogeneration is widely accepted in a number of facilities – from wastewater treatment plants to landfills to office buildings.

Plastic SUS waste is ideal for cogeneration, since its heat value is actually higher than coal. Burn the mixed plastics onsite and a firm's overall energy costs can drop, since the company creates its own highly efficient electricity and heat onsite, or sells excess energy produced back to the utility grid. Or if SUS waste is trucked to an off-site incinerator, consider negotiating credits if the incinerator operator has a cogeneration system.

According to the U.S. Clean Heat and Power Association, cogeneration systems:

- *Produce almost 8% of U.S. electric power;*
- *Save building and industry owners over $5 billion/year in energy costs;*
- *Decrease energy use by almost 1.3 trillion BTUs/year;*
- *Reduce NOx emissions by 0.4 million tons/year;*
- *Reduce SO2 emissions by over 0.9 million tons/year;*
- *Prevent release of over 35 million metric tons of carbon equivalent into the atmosphere.*

Jerold Martin of Pall Life Sciences encourages bioprocessing plant managers to think beyond just single-use systems when considering waste-to-energy/cogeneration for solid plastic waste management.

"Disposable technologies are just a portion of the plastic-based waste at manufacturing plants," he said. "There's also plastic packaging from shipments, scrap material, plastic labware and maintenance waste, and even plastics in the cafeteria. When examining the issue in this broader context, you begin to realize that waste-to-energy/cogeneration may indeed be an economical and responsible option."

In some instances, return on investment for cogeneration facilities is as low as 2-3 years because of the deep energy savings produced and incentives/rebates available. Several states and the federal government offer incentives for cogeneration installations, which can save companies thousands of dollars during installation or after. For example, the State of Washington offers a cogeneration and energy conservation public utility tax deduction to firms that install cogeneration systems.

Interested in learning more? The Department of Energy has created Clean Energy Application Centers across the country that promote cogeneration, waste heat recovery and other clean energy technologies and practices. They also offer regional assistance for specific projects. The Centers provide:

- *Market Assessments – Analyzing cogeneration market potential for various industries.*
- *Technical Assistance – Performing site assessments, producing project feasibility studies, and providing technical and financial analyses.*
- *Targeted Education and Outreach – Publicizing the benefits and applications of cogeneration through workshops, webinars, seminars, and training.*

Contact the Regional Clean Energy Application Center Closest to You:

Northeast - www.northeastcleanenergy.org
Mid-Atlantic - www.maceac.psu.edu
Southeast - www.southeastcleanenergy.org
Gulf Coast - www.gulfcoastcleanenergy.org
Midwest - www.midwestcleanenergy.org
Intermountain – www.intermountaincleanenergy.org
Northwest - www.northwestcleanenergy.org
Pacific - www.pacificcleanenergy.org
International District Energy Association - www.districtenergy.org

About Value Plastics, Inc.

Value Plastics, Inc. makes and markets an innovative line of fluid management components designed specifically for flexible tubing.

Products designed and manufactured include quick connect fittings, luer fittings, check valves, tube-to-tube fittings, threaded fittings and blood pressure monitoring components. Value Plastics products find global application in demanding healthcare OEM, research and specialty industrial applications.

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U.S. Dept. of Energy, Industrials Technology Program, Industrial Distributed Energy, www1.eere.energy.gov/industry/distributedenergy.