



Environmental Consciousness in Cleanroom Consumables Selection and Use

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How can the expectations of natural resource conservation and waste elimination be achieved in highly critical cleanroom manufacturing environments?

Environmental responsibility is no longer just an occasional headline in the news. It is expected socially and often mandated governmentally. Every day the public is demanding a decreased impact on the environment and an improvement to their quality of life globally. Every day new environmental regulations are introduced and government agencies are mandating change. In response, companies are announcing or improving “green” or “environmental responsibility” programs as their commitment to creating a better world. Initiatives to conserve our natural resources, eliminate operational waste, and produce more environmentally-friendly products are now both a corporate and customer expectation.

This article will focus on cleanroom consumables in the form of cleanroom wipers with a brief discussion included on cleanroom bond. The concepts of reduce, reuse, recycle, and biodegradability will be presented along with how to apply these concepts in cleanroom wiper and bond selection for reduced environmental impact. The most common cleanroom wiper materials will be presented with information about biodegradability or recyclability. Also, included will be product alternatives and methods of use that can lessen the overall consumption of wipers and limit the depletion of natural resources, such as high performance product selection and alternative packaging configurations. The article will further discuss pre-wetted wipers and their impact on volatile organic compound (VOC) emissions and alcohol solution waste. In closing, wiper options will be presented that reduce landfill impact through higher degrees of biodegradability when recycling is not an option.

UNDERSTANDING THE WASTE MANAGEMENT HIERARCHY

The waste management hierarchy is composed of three guiding principles: reduce, reuse, and recycle.

Reduce: To minimize environmental impact and produce less waste by purchasing more environmentally friendly products and improving methods to lessen consumption. Examples would include lighter weight, high absorbency wipers, and packaging configurations that use less packaging material.

Reuse: To use an item over and over prior to recycling or land filling. This is rarely done with cleanroom wipers due to the critical nature of the process and material requirements; however, there are some instances of reuse in less critical environments dependent on the ability to remove the contamination added by the original cleaning process.

Recycle: Recycling is the primary component of modern waste management and involves the collection and processing of used materials to produce the same or a new product. Leading examples include the recycling of corrugated and plastic packaging materials.

Implementation of any of the above three concepts will result in the following:

- Less waste of potentially useful materials.
- Conservation of natural resources that would be required to produce new materials.
- Reduced energy usage that would be required to produce new materials.
- Reduced air pollution.
- Reduced water pollution.

Once the three principles of the waste management hierarchy have been applied, the remaining waste must be incinerated or disposed of in a landfill. The landfill impact can be minimized by using materials that are biodegradable in municipal or commercial composting facilities.

Biodegradation: Is the process by which organic material substances are broken down by the enzymes produced by living organisms. Wipers made from natural fibers biodegrade while wipers made from synthetic fibers like polyester and polypropylene are almost impervious to biodegradation. In the case of blended wipers, the portion of the wiper composed of natural fibers will biodegrade, offering a degree of biodegradability.

RECYCLABILITY AND BIODEGRADABILITY OF COMMON CLEANROOM MATERIALS

Let's look at the recyclability and biodegradability of common cleanroom wiping materials, packaging components, and cleanroom bond paper.

Synthetic Fibers or Yarns: The most common synthetic fibers or yarns used in wiper fabrics are polyester, nylon, and polypropylene. These materials are petroleum based and are all almost impervious to biodegradation and are not renewable.

Cellulosic Fiber: Cellulosic fibers are natural fibers sourced from wood and are biodegradable. Depending on the wood pulp source, the fibers may be renewable and sustainable. The most common of these fibers found in wiping materials are cellulose (pulp), abaca, and soft wood.

Cotton Fibers or Yarns: All cotton fibers are 100% natural and are biodegradable. Cotton is also renewable and sustainable.

Regenerated Cellulose: These are cellulosic fibers that are regenerated through a special chemical process. The most common of these fibers found in cleanroom wipers are lyocell and rayon.

Corrugated Cartons: Corrugated cartons are biodegradable; however, due to the abundance of corrugated materials in the market, corrugated cartons should be recycled.

Plastic Bags or Pouches: The plastic bags currently used for cleanroom wipers are typically not biodegradable; however, once again due to the abundance of these materials in the market, the type of plastics used can be recycled.

Plastic Canisters: The plastic canisters typically used for cleanroom wipers are not biodegradable; however, they are often reused and can most likely be recycled.

Cleanroom Bond Paper: Cleanroom bond paper is made of cellulosic fibers which are biodegradable; however, a large majority of the cleanroom bond paper on the market is impregnated with a synthetic latex (to reduce fibers) which negatively affects the biodegradability and the recyclability. Cleanroom bond papers without the latex impregnation are biodegradable and recyclable.

MINIMIZING IMPACT THROUGH PROPER SELECTION AND USE

Now that we understand the waste management hierarchy, biodegradation, and the recyclability and biodegradability of common cleanroom materials and packaging, how do we apply this knowledge to minimize environmental impact when selecting and using cleanroom wiping materials and cleanroom bond paper?

Evaluate and choose the optimum packaging configuration.

Cleanroom wiping materials can be purchased in multiple packaging configurations. The best way to minimize the impact on the environment is to choose packaging configurations that contain the most wipers per carton or plastic bag or pouch. In this way, the amount of natural resources and energy used to produce those materials along with the amount of material to be recycled and the energy required for recycling is lessened.

Choose a wiper with higher absorbency.

When comparing wipers of the same material type, size, basis weight, and general cleanliness performance for spill pick-up or other similar types of applications, look at absorbency values. By choosing a wiper with higher absorbency, the amount of wipers required can be minimized.

Choose a wiper or bond paper with a lower basis weight.

When comparing cleanroom wipers or cleanroom bond paper of the same material type, size, absorbency and general cleanliness performance, look at basis weight. By choosing a wiper or bond paper with a lower basis weight, the amount of natural resources and energy required to produce the wiper are reduced and the weight of material that may be placed in landfills post use is reduced.

Be sure that operators are trained in proper wiper usage and cleaning techniques.

The use of improper wiping techniques can lead to increased wiper usage, increased solution usage, and decreased process and product yields. All of which lead to an increase in natural resources and energy consumed in manufacturing and an increased amount of material to be recycled or sent to landfills. Most leading cleanroom wiper manufacturers have produced cleanroom wiping guides for reference or can provide operator training in proper techniques as part of their technical service programs.

Evaluate the use of pre-wetted cleanroom wipers in place of in-house wetting techniques.

By utilizing pre-wetted wipers several environmental benefits can be derived:

- *Reduced volatile organic compound (VOC) emissions:* Many states, such as California, are now mandating reductions in VOCs and have put in place guidelines on the amount of VOCs allowable in products based on their intended use. Pre-wetted cleanroom wipers typically come in an easy to use re-sealable pouch that allows the extraction of one pre-wetted wiper at a time with very little VOC emission compared to in-house blending, spray bottles, and squirt bottles.
- *Reduced solution usage:* Alternative methods of wetting wipers in-house can lead to excessive solution usage. When using spray bottles or squirt bottles, the wiper can be over-saturated causing solution waste. There is also the waste associated with spills during in-house blending and spray or squirt bottle usage.
- *Reduced process and product waste:* Pre-wetted wipers ensure increased cleaning consistency and control due to very high wetting accuracy during manufacture and use. They can eliminate the potential for over-spray on sensitive parts when wetting dry wipers, thereby, increasing process and product yields, and reducing manufacturing waste.

CAN CLEANROOM WIPERS BE REUSED TO REDUCE ENVIRONMENTAL IMPACT?

To answer this question, we must first understand why cleanroom wipers are purchased. Cleanroom wipers are purchased to aid in the removal and/or control of contamination to levels that minimize the risk of process and product failure. They are primarily used in critical cleanroom environments where the purity of the wiping material and its overall performance characteristics are of extreme importance. Once the cleanroom wiper has been used in the cleaning process, laundering and returning the cleanroom wiper to anywhere near its original state would be extremely difficult. There is also the possibility that the re-laundered wipers could accidentally migrate back into the critical areas and severely impact process yields and final product integrity. For these reasons, it is not recommended or a typical practice to reuse cleanroom wipers. With this being said, there have been instances where a very few companies have been able to reuse the cleanroom wipers for more industrial or lower grade applications reducing the purchase of those types of cleaning materials. This is dependent on the company's capability to reduce or remove the

existing contamination to a level required for those applications.

CAN CLEANROOM WIPERS OR CLEANROOM BOND PAPER BE RECYCLED TO REDUCE THE IMPACT ON LANDFILLS?

In their original state, prior to use, most cleanroom wiping materials can be recycled; this is practiced by some of the leading cleanroom wiper manufacturers as part of their environmental programs. Post use recycling efforts can be difficult due to the types of contamination now contained on the wiper in the form of oils, solvents, or sludges. The best source to identify whether the wiper material can be recycled post use is your current recycler of materials. In the case of cleanroom bond paper, products that are not impregnated with a synthetic latex can be recycled in the normal paper recycling program.

NOW THAT ALL WASTE MINIMIZATION OPPORTUNITIES HAVE BEEN EXHAUSTED AND THE ONLY OPTION LEFT IS THE LANDFILL, HOW CAN THE LANDFILL IMPACT BE LESSENERED?

1. The first concern is to reduce the weight of the material that is going to be sent to the landfill. Hopefully this has been accomplished through the other waste minimization efforts that have been implemented. This is very important with knit cleanroom materials as these are exclusively made from petroleum based synthetic fibers that are almost impervious to biodegradation and is also important with latex impregnated cleanroom bond paper.
2. In the case of non-woven or woven cleanroom wipers and cleanroom bond paper, choose a cleanroom wiper or bond paper material that is biodegradable and that has all of the performance characteristics required to meet the process needs.
3. In the case of blended or bonded non-wovens, choose a cleanroom wiper that contains the highest amount of biodegradable material and that has all of the performance characteristics required to meet the process needs.

SUMMARY

Environmental consciousness and critical cleanroom consumables do not have to be mutually exclusive. With knowledge of basic waste management principles, the environmental properties of common cleanroom materials and proper cleaning methods, a significant reduction in environmental impact can be achieved. Further help in lessening the environmental impact of cleanroom consumable materials can also be sourced through cleanroom wiper manufacturers as part of their Cleanroom Wiper Usage Audit programs.¹

Reference

1. Webb, Duane. "The Cleanroom Wiper Usage Audit." Controlled Environments Magazine, June 2009.

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