

Industry Insights: Making Sustainable Choices in the Adhesive Tape Market



Making and delivering a roll of pressure-sensitive adhesive tape impacts the environment in many ways.

With the world’s resources at greater risk than ever before, our industry is under increasing pressure to become more environmentally friendly. Pressure sensitive adhesive tape (PSAT) manufacturers and consumers alike are responding by introducing environmentally responsible processes and products into our businesses.

Following an historical overview of PSATs, this paper will examine the ways that different components of the PSAT supply chain—including adhesives, tape cores, backings, and packaging—impact the environment. We will then look at how sustainability is being incorporated into the PSAT supply chain. Our hope is that this paper will assist you in making more environmentally informed choices when choosing your PSAT suppliers and products.

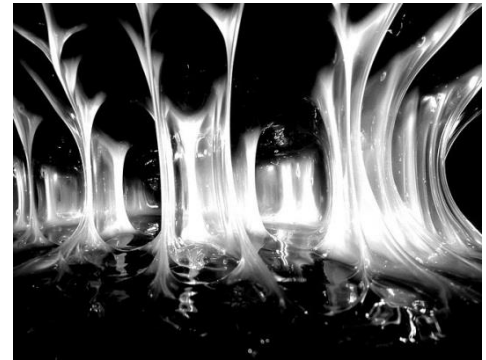
A BRIEF HISTORY OF PSATs

The earliest known PSATs were made from natural rubber and rosin (a solid form of resin obtained from pines and conifers) that was coated onto its backing by the roll-casting process. The adhesive mixture was thinned out with solvents and then applied to film, paper, fabric, foam, and foil backings. The solvents were boiled off in long ovens, exposing a sticky substance sensitive to pressure—and expelling toxins directly into the atmosphere.

The first “official” pressure sensitive adhesive tape was developed in 1845 by a surgeon who applied a natural rubber adhesive to strips of fabric, producing a crude surgical tape. The next major application for pressure-sensitive tape came from the auto industry in the 1920s, with the invention of paint masking tape. Then, in 1929, DuPont discovered a new film called cellulose. A failure in its initial application as a tape for waterproofing insulation, cellulose proved highly successful as a film carton sealer. Foils and foil laminates later proved themselves in the insulation closure challenge as tapes to close duct work.

Water activated glue paper tape, gummed Kraft paper tape, glass reinforced filament tape, and other film products followed rapidly, providing solutions for every possible tape need. Eventually, foams were added to the solution set for bonding and attachment applications.

The innovative use of new and varied materials created a range of PSAT solutions; however, little was done to address legacy PSAT environmental issues—and, sometimes, the new products and processes introduced new threats to sustainability.



The old way of creating adhesives—and toxins

ADHESIVES: ENVIRONMENTAL ENEMIES OR JUST MISUNDERSTOOD?

Adhesives are, of course, the essential component of pressure sensitive adhesive tapes. They also have earned a reputation as being among the worst environmental offenders in the PSAT supply chain which, as we will see, is not entirely merited.

Adhesives on good-quality PSATs are fastened to the backing with a primer. As a result, these tapes do not cause problems in most recyclable disposal processes. Tapes that *cannot* be recycled are plain adhesives without any backing and tapes that adhere poorly to their backing.

Battling “The Stickies”

When a tape’s adhesive is not stuck firmly to its backing, the adhesive becomes a loose mass of smaller particles—known as “the stickies”—during recycling. These smaller particles become deformed under the heat and pressure of processing, making them difficult to screen or filter out.

Hot-melt adhesive is the number one material contributor to the recycling stickies. Unlike pressure sensitive hot-melt tapes, which feature adhesives firmly anchored to tape backings, hot-melt adhesives are not anchored to a backing. As a result, residual hot-melt adhesive material in the processing slurry discolors the recycled resin and mars the recycled paperboard, limiting its marketability and value.

The stickies are often cited as the major issue in paper resource recovery, and it is their sheer volume that makes them the biggest offender. Of the 25 billion square yards of PSATs sold worldwide each year (PSTC Tech 35), it is estimated that tape is less than 0.01% by weight of the total waste stream, and its packaging represents less than 1% (*New Scientist*, 1990).

Balancing Performance with Sustainability

Adhesives used for tape products have not changed appreciably over the years. Typical adhesives include:

1. Rubber, acrylic, and silicone-based adhesive on various backings designed to fit specific attachment challenges. These adhesives can be either natural or synthetically modified in various ways with tackifiers, oils, fillers, cross-linkers, stabilizers, pigments, or other additives coated by a casting process.
2. Hot-melts, typically coated by extruder machinery.
3. Water dispersion acrylates that are coated by casting.

The latter two are low-emission green adhesive technologies with specific shortcomings: targeted adhesive properties are difficult to obtain from these formulations, and elevated temperatures and high-shear property restrictions are inherent. New developments in UV curing and photo cross-linking green technologies, however, display progress and promise for the future. By exposing adhesives with photosensitive molecules to light,



Adhesives can be melted in a hot-melt glue gun and dispensed directly, or the molten adhesive can be held in vats and pumped to various operators using a modified gun without heating elements.

manufacturers save energy, reduce toxic emissions, and alleviate the need for such harmful chemicals as chromium and platinum that are used in thermal curing.

Environmental concerns—including global pollution related to film and adhesive manufacturing—do exist, although they are minimal. To encourage the development and use of new, more environmentally friendly manufacturing and production technologies and processes, governmental regulation of emissions have become increasingly strict.

In the PSAT industry, a solvent recovery technology used during adhesive coating has proven to be both highly effective and environmentally friendly. In this process, spent solvent vapor from the oven is captured and cooled, and the liquid solvent is drawn off and reused over and over again. While it is expensive, this technology offers compelling environmental advantages, especially for companies replacing aging equipment.

Pressure sensitive tape is not yet 100% eco-friendly; however, producers and users can work together toward creating a more significant impact. Tape producers can employ labor, energy, and material savings processes, including solvent recovery, water dispersions, photosensitive adhesive curing, and formulations of predominately reprocessed natural rubber gum. The property most affected by these more environmentally friendly processes is high-temperature performance. For now, users can design around this shortcoming with innovation, time, research, and qualification.

The major environmental drawback to producing and consuming poor-quality tapes is their incompatibility with the recycle formulations of complex acrylics and silicone adhesives, which necessitates thermal destruction rather than recycling or composting. As a result, environmentally responsible companies should manufacture and use these adhesives sparingly.

TAPE CORES HAVE GONE GREEN

Every roll of tape has a core that becomes waste after the tape is used up. These paper and/or plastic tubes are produced either to high and consistent specifications, or loosely for fit-for-use applications.

Recyclable Paper Tubes

Green packaging manufacturers produce a variety of tubes for numerous commercial and retail purposes, and for many different industries. In our industry, spiral paper tubes (*pictured*) are part of the entire PSAT manufacturing and supply chain, from manufacturers, converters, distributors, and retailers to printers and contractors. Vendors committed to the environment use 100% recycled paper when manufacturing these paper tubes, resulting in packaging products that are completely recyclable.



Tape cores are among the greenest components of the PSAT supply chain.

The vast majority of suppliers have an active reuse policy whereby extended tubes are shuttled back and forth between the user and the manufacturer. As a result, thousands of tons of waste paper are recycled each year, allowing hundreds of thousands of trees to remain untouched.

Paper tube producers have been leading the way in demonstrating the rewards of going green. With almost 100% of the industry in compliance to produce strictly from recycled paper, the accepted good manufacturing practice (GMP) has become the most economical way to produce paper tubes in this business.

Most manufacturer-printed tape cores cannot be recycled easily. If the industry moves away from printing on the core and toward greater use of eco-friendly labels, tape cores will become the most sustainable of the tape components.

Recyclable Plastic Tubes

While recyclable plastic tubes are used less frequently than their paper counterparts because of their expense, it is worth noting that plastic tubes made from bio-plastics typically are manufactured from Polylactic Acid (PLA) and are fully recyclable.

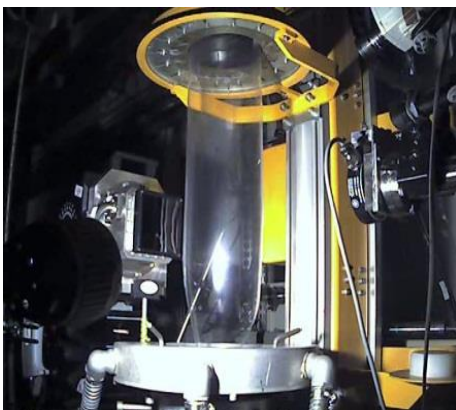
BACKINGS: IT'S ALL IN THE MATERIAL

Backings with PSA Coating (Skeist, 2002)	Millions Sq. Yd.
Paper	14,425
Film	11,720
Foil, Fabric and Foam	625
Other	2,282

World-wide PSA coated production figures for the 5 most popular tape backings

PSAT backings are made from many different materials to meet every possible tape requirement; however, the only truly green tape backings are paper, non-petroleum based films, and fabric. Paper and fabric backings are completely biodegradable, while films are a bit more complex.

Tapes produced with bio-plastic film containing oxygen or UV agents will accelerate degradation within a reasonable time by air or light. Petroleum-based plastic, however, simply breaks down into smaller pieces. Microorganisms are unable to digest the polyethylene, polyester, or polypropylene films.



Plastic film production

Bio-plastics are sustainable alternatives to traditional hydrocarbon based plastics. Some plastics are even made from renewable resources (plants like corn, tapioca, potatoes, sugar, and algae), and they will break down faster than traditional plastics. When using film tapes, always opt for a biodegradable, rather than a petroleum-based, film.

Foam tapes are made primarily from closed-cell polyethylene (PE) or polypropylene (PP) foam. While neither one has a commercially acceptable green alternative, both are a vast improvement over polyvinyl chloride (PVC) foam. While PVCs can be recycled by mechanical means, they are full of chemicals and heavy metals that are highly polluting and dangerous when burned or heated.

Foils and foil laminates corrode cleanly into the soil, but they also can be melted for reuse.

The selection of a backing that is both responsible to the planet and appropriate for the application is a challenging one. Necessity is the mother of invention... and innovation. As backing suppliers respond to the needs of their consuming partners, the supply of eco-friendly, sustainable substrates will increase.

PACKAGING: PAPER OR PLASTIC?

Tape Packaging

Landfills are filling up fast, and it is estimated that paper-based packaging is taking up to 32% of the landfill space (Earth 911, 2005). With the tremendous growth of the industrial world, expanding landfills place enormous stress on the environment, particularly on trees.

While recycling helps, some new raw material is required to make paper-based packaging boxes—even to produce low-fiber cardboard and corrugate. At minimum, in order for a green initiative to be sustainable, we must replant what we consume. This amounts to over 4 billion trees annually. In global human terms, that is a 100 foot tall Douglas fir tree per year, per person (EPA, 2008).

Recycled paper packaging consumes only 60% of resources to make new packaging from virgin materials. This is a huge savings, and not only in the material itself: 74% less air pollution is produced and 50% less water is consumed. In other words, one ton of recycled paper saves 17 mature trees, 7,000 gallons of water, three cubic yards of landfill space, two barrels of oil, and 4,100 kilowatt-hours of electricity, which is enough energy to power the average American home for five months (EPA, 2008).

Businesses that really want to go green are using more film and less paper in their packaging. Bio-degradable stretch film, shrink film, and other newly altered films offer two major green advantages:

- they eliminate the need for paper containers (for example, an accordion style put-up); and they melt away in the landfill graveyard rather than becoming the unusable, moldy mess that corrugate packaging turns into when it gets wet.



Biodegradable films are environmentally friendly tape packaging choices.

Transport Packaging



Corrugate recycling has been highly successful in some parts of the world, but not as much in other areas.

Until recently, the accepted practice of transport packaging was a wooden pallet piled as high as box strength would allow. Although not a lot has changed, the introduction of stretch film has all but eliminated the need for metal strapping, which has been replaced by glass filament reinforcement tape and 100% plastic strapping. As mentioned in the previous section on tape packaging, many producers have incorporated biodegradable polyethylene and polypropylene films into their portfolios.

Because of its size, corrugated transport packaging is generally reused and recycled, rather than deposited in a landfill (as smaller corrugate packing often is) to decay and take up space. Recycling corrugated transport packaging is a proven, effective green measure, and evidence from more than 20 years of studies shows conclusively that adhesive tape and stick-on labels do not hinder the recycling process.

How effective has the corrugate recycling movement been worldwide? Recycling of shipment corrugate has been as high as 87% in Canada and 80% in Europe, while corrugate recycling in the United States averages only 63.4% (Earth 911, 2009). The Canadian figures are particularly remarkable when compared to their environmental impact effect. In fact, if only Quebec and Ontario implemented a ban on Old Corrugated Cardboard (OCC), the estimated effect would be like removing 15,000 automobiles from these two provinces (*Packaging Digest*, 2012). Active recycling and re-use programs not only will provide much needed, low-impact raw material for new packaging, higher participation rates in these programs will ensure a sustainable flow of material components for producers and manufacturers.

WHAT WE CAN DO NOW

While some businesses are keen to be on the cutting edge of the global environmental movement as it relates to sustainability, most aspire to be better world citizens by substituting materials when and where they are comfortable doing so. Some ways that the PSAT industry can move slowly and steadily toward sustainability include:

- Adding a few extra yards on a roll of tape (for example, producing 50-yard rolls rather than 36) to provide more product-dense shipments, which conserves labor and energy;
- Requesting pallets to be wrapped with bio-degradable stretch or shrink film, which frees up space in landfills;
- Using an outer master reusable carton (a Gaylord), which saves additional interior packaging and various remanufacturing resources.

In addition to their comfort level benefits, small performance increases and new tape product design alterations are easier for most companies to achieve operationally than a long requalification process resulting from using an alternative backing or modifying or substituting adhesives. Even a liner change may initiate a review process for its impact on who consumes and gathers the waste from a “newly created” tape product. Most users can make changes to labels, cores, boxes, and packaging without a total product re-evaluation and qualification.

Universal sustainability remains a complex issue. The product that will degrade 100% over time enjoys only selective success. Pressure sensitive adhesive tapes are meant to be temporary solutions, not problems for the environment that will last for many lifetimes. PSAT manufacturers and customers must work together to create new solutions that will help forge a more sustainable supply chain—to the benefit of our industry and our planet.

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For more information on sustainability in the PSAT industry, or if you have a suggestion for ECHOTape, call us: (800) 461-8273 or e-mail: info@echotape.com.