

Zero Waste Roofing

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Abstract

Target Corp., Minneapolis, a leading retailer, pursues a comprehensive sustainability strategy in the construction and operation of all its facilities. Material management is a critical element of this strategy. One of Target's most ambitious goals is to achieve "zero waste" on all its roofing projects—new construction and reroofing. The genesis of this plan is a proactive approach to roof asset management that mandates roof membrane replacement in advance of roof system failure, which allows for reusing insulation and cover boards. Since 2007, working with Sika Sarnafil, Canton, Mass., a manufacturer of thermoplastic PVC roof membranes, Target has been able to have its thermoplastic PVC membranes recycled into new material at the end of their service lives. The approach has diverted an estimated 28,000 cubic meters (1 million cubic feet) of insulation and cover board, as well as more than 450,000 kilograms (kg.) (1 million pounds) of roof membranes from landfills. More recent initiatives have focused on recycling scrap materials, packaging and other debris generated during the installation

process in new construction and reroofing. Experience gained through more than 30 projects totaling about 372,000 square meters (4 million square feet) will be shared. Technical and logistical obstacles and how they were overcome, as well as ongoing challenges, will be highlighted. The economic effects and overall benefits achieved also will be presented.

Authors;

Michael Fenner started his career in roofing working in the construction industry as a roofing laborer while attending college. He spent over 22 years working for several roofing manufacturers including Firestone Building Products and GenFlex Roofing Systems. He has held various technical and contractor service positions with these manufactures. He has been involved with roof inspection, warranty service, contractor training, product testing and development throughout his career.

Mr. Fenner joined Target in 2004 as a Field Project Manager responsible for internal field roofing operations. He was promoted current position in 2007. He is responsible for managing the life cycle of exterior building assets for Target with a department of 38 team members.

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Engineers Ontario, and of the Roofing Consultants Institute. He is currently active on Committees within the Cool Roof Rating Council, the Chemical Fabric and Film Association, and the Center for Environmental Innovation in Roofing. He has a Bachelor of Applied Science (Chemical Engineering) degree from the University of Ottawa and a Masters of Business Administration from the International Institute for Management Development, Lausanne, Switzerland.

Target Corporation: A long history of environmental leadership

Target Corporation is considered a leader amongst American companies in environmental stewardship. As they build their stores in the communities where their guests and their team members live, work and play, they are deeply mindful of the impacts each facility can have. They pursue sustainable design and construction practices, resource preservation techniques, and focus on energy efficiency and reducing their overall carbon footprint. Their first initiatives go back decades. Target was one of the first retail companies to adopt a “Reduce, Reuse, Recycle” policy, beginning with the recycling of cardboard in their stores in the 1960s. Many of today’s initiatives are focused on energy conservation and the accompanying reductions in green house gas generations. Target is striving to have all their stores meet the strict energy performance standards set by the EPA and to ultimately be Energy Star Certified, through the use of high efficiency heating and cooling systems, low wattage lights, LED lights and motion sensors in cooler and freezer display cases, and reflective roof membranes, to name but a few initiatives. The original focus on the “three Rs” has only gotten stronger with time. Ceiling tiles and display shelving from store remodels,

light bulbs and obsolete computer equipment are all recycled. Target's ultimate goal is "zero waste", however they have set an interim objective of 80% recycle of roofing waste; additionally 50% of all their construction waste.

Target encourages and facilitates recycling by their guests by providing in-store collection stations for plastic bags, glass, plastic and aluminum containers, cell phones, MP3 players and ink cartridges. They estimate that this program will divert up to six million pounds of waste from landfills annually.

The following paper will outline how roofing, and more specifically roof material selection, re-use and recycling, has become an important part Target's portfolio of sustainability activities.

Sustainable Roofing Program

Roofs are a critical element of large, single story retail buildings. Roof leakage can damage inventory, and interior finishes. Although an issue in any business, the impact is particularly acute in the extremely competitive retail sector. Even more importantly, leakage can lead to slip hazards for guests and employees. In a typical Target store, the roof represents more than three quarters of the building's envelope. Roofing system selection has a significant impact on construction cost, and ongoing maintenance and energy expenses, and ultimately replacement cost.

Approximately 20 years ago, Target began using thermoplastic polyvinyl chloride (PVC) roofing membranes on their stores and warehouses. Over the years PVC was found by Target to provide the greatest durability and ease of maintenance. Approximately ten years ago, Target settled on PVC as their primary roofing membrane. They have found

that using a single membrane type has paid significant dividends. Consistent specifications lead to higher quality installations. A strong institutional knowledge of the material is created, facilitating maintenance and repairs across their 1,819 facilities. This also contributes to a high degree of accuracy in their end of service life projections for planning purposes.

With such extensive experience with the material, Target was also at the leading edge in recognizing the energy saving potential of light colored PVC roofs. In 1999, they participated in a jointly funded DOE/ EPA study conducted by Lawrence Berkeley National Laboratory (LBNL) that was one of the first to quantify energy savings from cool roofs.

Recognizing roof systems' importance to their overall operations and costs, Target has developed a comprehensive life cycle asset management system for them. Preventative maintenance roof surveys are conducted on every building four times per year by store staff. All observed defects are logged in a central data base, as are repairs and other follow-up actions. Using predictive analysis tools, the remaining service life of each roof is estimated, within plus or minus two years. Roofs deemed requiring replacement are subjected to an additional inspection by a member of the corporate roofing team before a final decision is made.

This systematic, pro-active management of their roofing assets provides numerous benefits. Interruptions to store operations due to roofing problems are minimized, and roof service life is maximized. Roof replacements are budgeted for and executed well before complete system failure is experienced.

With few exceptions, when the roof is replaced as it approaches the end of the membrane's service life, the thermal insulation and cover board (where installed) are still in very good, serviceable condition. The removal of the mechanically attached PVC membrane does little if any damage to the boards below. Any other mechanical or moisture damage that may exist is typically limited to small localized areas. Most, if not all, of the insulation can be left in place, with any damaged or wet material removed and replaced with new. Additional insulation or cover board can be added to meet current code requirements as required, before a new membrane is installed.

This results in significant costs savings, with insulation typically representing more than half of the material costs in a typical mechanically attached PVC roof membrane assembly. Labor costs to remove the old, and install new, insulation and cover board are also avoided.

From a sustainability perspective, approximately 730 m³ (26,000 cubic feet) of waste is diverted from the landfill every time Target replaces a membrane without having to replace the insulation on one of their stores. The existing material will provide decades of additional service under the new membrane, avoiding the use of raw materials and energy that would have been required to produce replacement material.

From a building code perspective, the build-up is generally considered a single roof system, allowing them to simply recover the entire roof in the future should the need arise for any reason.

Target had developed arguably the most sustainable model possible with regards to their roofing operations: using light colored membranes to minimize cooling costs, selecting the longest lasting thermoplastic membranes, maximizing service life through

a comprehensive maintenance program, and salvaging insulation and cover boards. There was, however, still room for improvement. All the membrane material being removed from the roof was being sent to landfill. On a typical store, this represented more than 14,000 kg (31,000 lbs) of membrane material being disposed of from every roof replacement. If Target could recycle the material, they would be very close to achieving their objective of zero waste roofing projects.

Membrane recycling

Recycling thermoplastic PVC roofing membrane is not a new concept. Most PVC membrane manufacturers have been recycling production trimmings back into new products such as walkway pads for decades. Even end of service life recycling of PVC membranes goes back many years. European PVC membrane manufacturers began doing so in the early 1990s. One American membrane manufacturer conducted their first trial in 2005. Membrane from the Marriott Long Wharf hotel in Boston was salvaged during re-roofing and used in the production of PVC roof walkway membrane.

In May of 2007, Target's Silver Spring, Maryland store was scheduled to be re-roofed. It was an ideal opportunity for Target's first attempt at membrane recycling. They worked with the vendor of the roof replacement material to recycle the membrane (from another vendor) that was being removed, prior to the installation of the new PVC membrane.

The process

In a typical tear-off on a mechanically fastened single ply, the old membrane is cut along the edges of each row of fasteners, resulting in strips nominally 1.8 m (6 ft) wide. The strips are cut to length, typically 31 m (100 ft) or more, and rolled or bundled and tossed into a dumpster, intermingled with all the other tear-off debris such as insulation, fasteners, metal, etc.

On a recycling project, the membrane must be separated from the waste materials and prepared for shipping to the processor.

In an effort to maximize the amount of material on a truck for shipping, on the first project in Maryland, the old membrane was cut into 600 mm (2 ft) wide strips, approximately 9 m (30 ft) in length, rolled and taped to prevent unrolling. This resulted in more than twice as much cutting, and increased handling.

Ideally, beyond segregating it, the contractor would not have to handle the material any differently than they would on a tear off with disposal. Attempts were made, on non-Target projects, to cut and bundle the materials in the usual manner (i.e. cut about 1.8 m (6 ft) wide, and roll or bundle). There were however challenges palletizing the material in a manner that was safe for removal from the roof by crane, optimizing the use of shipping space in the trucks, and in handling the material at the processor's facility

Through a variety of trials, it was found that cutting the membrane in strips 915 mm to 990 mm (36 in to 39 in) wide, by about 15 m (50 ft) in length, and loading them in "Gaylord" boxes (very heavy duty cardboard boxes), approximately 1.2 m (4 ft) cubed is the best approach to date. Cutting has been reduced to about 50% more than for a

typical tear off and disposal, the Gaylords can be strapped to pallets and easily unloaded from the roof and into a tractor trailer, and the material can easily be handled by the processor.

Over time it was also found that simply tack welding the end flap of membrane secured the rolls, was quicker and eliminated the need for taping them.

Generally the original membrane fasteners and plates are left in place and are simply covered over by the new assembly. Any fasteners and plates that are removed are consolidated with any other waste (wood skids, all manner of packaging, etc.) generated during the project to be recycled by Target's disposal vendors.

During the installation of the new roof, scraps, trimmings and other excess membrane material is also thrown into the Gaylords for recycling, minimizing waste generation during the roofing process.

In a typical PVC roof membrane recycling project, the contractor is responsible for removing the membrane, "packaging" it, and unloading it from the roof and into the tractor trailer for shipping. The membrane manufacturer that is taking the material back assumes all costs for freight from the roof's location onward, and for processing of the material into a usable form.

There is a slight amount of additional labor, and therefore cost, involved for the contractor to remove, consolidate and prepare the material for shipping. Target has found that this is off-set by the reduction in dumpsters required, as well as the disposal costs that are avoided.

From a building owners and a contractor's perspective, the process is very simple, and is done at little, and generally no, additional cost.

Recycling the material

Leaving the construction site, the membrane is shipped to the processor where it is pulverized into a very fine powder for recycling.

The powder is sent to the membrane manufacturer where it will typically be recycled into one of three products: thick, textured walkway membrane, protection sheet for vegetated roofs or into new roofing or waterproofing membrane. Target's vendor/recycling partner typically recycles competitor's PVC membranes into the former two products, their own into the latter. In all cases, the material is being recycled back into high value membrane products that will provide decades of service. These products can in principle be recycled an infinite number of times, creating a closed loop process for the raw materials that were originally used in producing the membrane.

At this time only loose laid and mechanically attached membranes can be recycled. Contaminated with adhesive and remnants of plywood, insulation facer, etc., flashings are not currently recycled. Preliminary trials with such materials have been encouraging, and it is believed that in the not too distant future, adhered materials will be recycled in much the same manner as loose laid membranes at the end of their service life.

Recycled Content Certification

Owners like Target Corporation that are serious about their environmental initiatives want to insure that the claims being made, and the programs they are involved in are legitimate and not simply "Greenwashing". With regards to recycling, they want to

insure the materials are being recycled as claimed, and not simply being indirectly disposed of or being down-cycled into disposable or short life products where the overall benefits of recycling are questionable from a life cycle environmental perspective. Until very recently, there was no way to verify through a third party that recycling claims being made by a manufacturer were in fact accurate. Underwriters Laboratories has stepped in to fill that void, with the creation of UL Environment (ULE), a wholly owned subsidiary of the well known and highly regarded testing agency. ULE provides a variety of services, including a variety of Environmental Claims Validations (ECV).

For recycled content ULE analyzes the supply chain of the recycled components, including the origin(s) of the recycled materials used, the steps and processes used from sourcing to the incorporation of them into finished goods. They audit internal processes to insure that each step in the custody chain, and manufacturing processes, formulations and batch records are documented, verifiable, etc.. Subject to a successful evaluation, ULE certifies the claim (e.g. recycled content) is valid and is in accordance with the Federal Trade Commission's 16 CFR Part 260 – Guides for Use of Environmental Marketing Claims. Target's partner vendor/ recycler was the first (and at the time of writing of this paper, the only) supplier of low slope, commercial roofing products, to have certified their recycled content claims through ULE.

Evolution of the program

After a successful project in Maryland, Target has since worked with the same vendor on more than 30 additional projects. In total, approximately 372,000 m² (four million

square feet) of PVC membrane that had reached the end of its service life has been recycled from these projects. This represents in excess of 450,000 kg (one million pounds) of material that just a few years ago would have gone to landfill, but have instead been converted into new roof membrane products that will provide decades of service in the field. These roofs have been located in at least 15 different states, broadly dispersed around the country.

Beyond the success of the Target program, the vendor/ recycler has worked with numerous other building owners and customers around the country in the same manner, albeit generally on a more reduced scale. In June of 2009, the program was recognized by the Commonwealth of Massachusetts Office of Energy and Environmental Affairs for the "...groundbreaking resource recovery program for roofing materials", and for "...literally taking recycling to new heights".

The program continues to grow, and in 2011, the partners anticipate recycling the membrane from more than 30 stores, essentially doubling the quantity recycled to date by Target.

Ongoing efforts are focused on further reducing the field handling, and bettering shipping efficiencies. This will only further enhance what has been tremendous success, allowing Target to meet or exceed their objective of recycling 80% or more of waste materials on their roofing projects, and bringing them close to their long term objective of "zero waste" on these projects.

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