

CONTAINER MANUFACTURING PROCESS



ROTO Industries, Inc. operations are located on 3 acres in Anaheim, California. Our manufacturing area is over 25,000 square feet. We operate three (3) 1991 Rotational Engineering 140" Ovens. These machines are four (4) Arm Rotational Molding Machines. We are capable of producing over 1,200 containers per day.

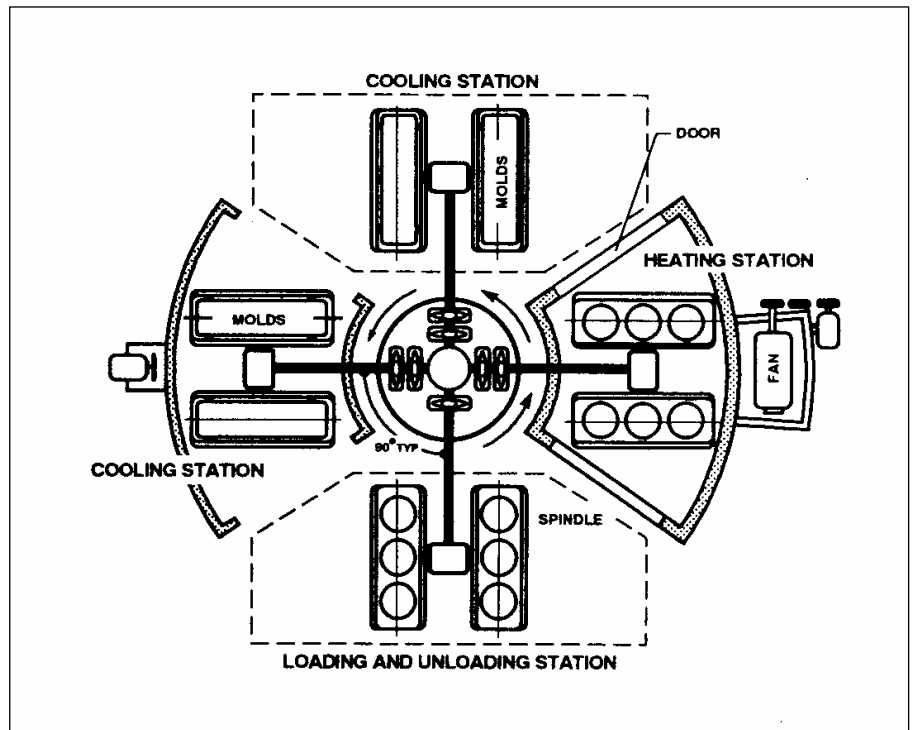
OUR MANUFACTURING PROCESS

There are many refuse container manufacturers in the country who utilize one or more of the following processes depending on the application:

- Rotational Molding
- Blow Molding
- Thermoforming
- Injection Molding
- Structural Foam Molding

Roto Industries, Inc. utilizes the Rotational Molding manufacturing process, which is the only process that allows you to manufacture the highest quality resin on the market (Crosslink High Density Polyethylene).

We use Four (4) Arm Rotational Molding Machines that enable us to "Air" cool the molds. This process allows the product to release itself uniformly from the mold and creates a quality of workmanship that is unsurpassed. In contrast, Three (3) Arm Rotational Molders must "Water" cool their molds. Water cooling produces areas of the finished product that release unevenly from the mold thus developing a "Warpage" in the product.



ROTATIONAL MOLDING –ADVANTAGES

- Low Equipment and Tooling Costs.
- Uniform Wall Thickness on Parts.
- Low Resin Waste Rates.
- Lowest Levels of Molded-In Stress.
- Economic for Both Small and Large Productions

ROTATIONAL MOLDING – THE PROCESS

A cold mold is filled with the correct weight of a powdered plastic resin. The mold is placed in an oven and rotated simultaneously about two perpendicular axes. During this stage, a uniform layer of resin is deposited on the inside of the mold and the resin fuses together. The mold is then cooled while continuing to rotate. After cooling, the part is removed from the mold and more resin is added to repeat the cycle.

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RESIN SELECTION / HIGH DENSITY - CROSSLINK POLYETHYLENE

In every molding process, the quality and success of any application depends upon the right material and a suitable product design. A Crosslink High Density Polyethylene Resin offers you these advantages:

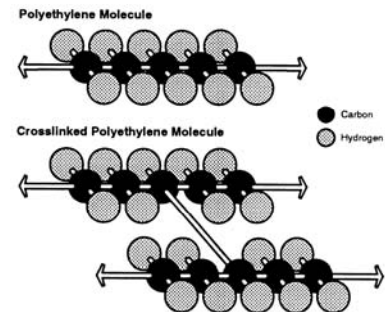
- ✓ Excellent toughness and durability
- ✓ Proven long term performance and service
- ✓ Excellent low temperature properties
- ✓ Economical
- ✓ Superior chemical resistance
- ✓ High impact strength
- ✓ Light weight
- ✓ Abrasion resistant
- ✓ Stain resistant
- ✓ High dent resilience

PROPERTIES OF CROSSLINKING RESINS

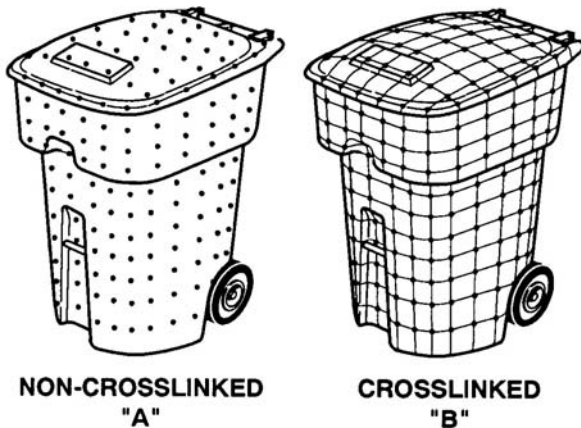
Crosslink High Density Polyethylene Resins have been used in the refuse containers in Tempe and Scottsdale, Arizona, area since 1971 in temperatures exceeding 100 Degrees. In Phoenix, Arizona nearly 90 percent of all containers entered into service in December of 1974 are still in service. In Billings, Montana, containers formed from Crosslinkable resins have 16 years of exposure to temperatures at -40 degrees below zero with equally impressive results. Imagine the results that you could experience living in a more temperate climate.

MOLECULAR STRUCTURE

Polyethylene is a long chain polymer of repeating groups, each connected to two hydrogen atoms. The individual molecules are very long with a carbon "backbone" formed by the carbon atoms connecting to each other. The polymer contains millions of these long molecular chains, each hopelessly entangled with all of its neighbors. The strength of the molded part lies in the complexity of that entanglement. When crosslinking occurs, the molecular weight increases with resulting improvement of the physical properties of the polyethylene.



ONE GIANT MOLECULE



Crosslinking polyethylene compounds contain chemical agents designed to create a molecular change during the molding process, which results in the polymer molecules becoming interlocked (Crosslinked) with each other. Other polyethylene resins bond with each other during the molding process by surface attachment only, while Crosslink creates a chemical interlocking bond between the molecules that is "in a sense" one giant molecule.

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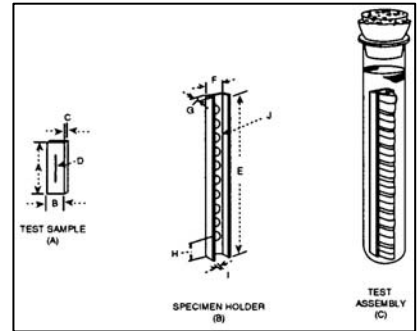


ENVIRONMENTAL STRESS CRACK RESISTANCE




Polymer Engineers consider this the “Acid Test” of container performance. Stress resistance under chemical stress is highly correlated to mechanical stress. The most durable container resin will be the one that has the highest ESCR number. The chemical environment of a refuse container could include cleaning agents, chemicals, paints, nail polish, foods and even some types of industrial type waste. This doesn’t mean that a resin that has a low ESCR number can’t do the job but that it just won’t last as long.

The environmental stress crack resistance (ESCR) of a resin gives an indication of how a part will perform when in contact with a chemical stress cracking agent or under mechanical stress. A material with excellent ESCR should be required as most refuse containers are subjected to a variety of stress cracking agent and are constantly under mechanical stress.

The ESCR is determined on 1 ½” x 12” specimens die cut from a flat molding. The specimens are notched, placed in a holding device, and stressed by bending 180 degrees. Stressed specimens are then placed in tube of 100% Igepal (chemical stress cracking agent similar to soap or detergent) or solution of 10% Igepal and water. The 10% solutions is a more severe test.



The tube is immersed in a water bath maintained at 122 degrees F (50 C), and the time required for each sample to fail is recorded. From this data, an F50 value (time required to fail) is calculated. The test should be terminated after 1000 hours. Beyond this point, the test temperature relaxes the stresses introduced by bending, and additional testing time is meaningless. A F50 value of over one thousand (1,000) hours is exceptional.

Test	ROTATIONAL EXLP	BLOWMOLDED HDPE	INJECTION HDPE	ROTATIONAL LMDPE
Density	.940 - .943	.95	.945	.939
Environmental Stress Crack Resistance 100% Resistance 10% 	1,000> 1,000>	600 600	30 40	1,000> 480
Low Temperature Impact 	70,190	60,NA	60,NA	60,170
Elongation	450	600	400	400
Tensile Strength 	2,700	3,800	3,200	2,800
Cart Manufacturer	ROTO Industries	Zarn	Otto, Schaefer, Rehrig, Cascade	ROTO Industries

NOTE: High Density Crosslink Polyethylene (XLPE) has superior ESCR and Low Temperature Impact values – The two (2) most important tests as related to refuse containers. Blow Molded and Injection Carts have higher

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Tensile Strength values but a higher number is not better. This means they are stiffer. A trash cart should be flexible and give so it will not snap and bust.

IDEAL RESIN APPLICATIONS

Each Resin has an ideal application. The problem is that some manufacturers use a resin created for less strenuous applications in an application that demands the highest quality resin for durability. They know that their resin does not have the resin properties of the more suitable resin (Crosslink) but speculate they will perform adequately in the application. They substitute a lower cost resin for competitive purposes.

NOTE: It is important to remember that the lowest cost resins also have the highest replacement rates under warranty. These resins are more suitable for applications that are not subjected to chemical, environmental and mechanical stresses.

SUITABLE POLYETHYLENE APPLICATIONS

- **Crosslink High Density Polyethylene –(XLPE)**

Refuse Containers, Agricultural and Chemical Containers, Gas Containers, Waste Disposal Tanks

- **Linear Medium Polyethylene – (LMDPE)**

Refuse Containers, Liquid Bulk Handling Systems, FDA Approved Drums and Tanks, Stadium Seating

- **High Density Polyethylene – (HDPE)**

Restaurant Salad Bars, Food Storage Containers, Ice Chests, Traffic Barricades

- **Low Density Polyethylene – (LDPE)**

Household Trash Bags, Photography Film, Food Packaging Materials

PHILLIPS 66 RECOMMENDS CROSSLINK

These other resins are good materials but the chemical reaction that takes place to Crosslink the polyethylene molecules dramatically improves the characteristics of Crosslink polyethylene over every other type of polyethylene. Phillips 66 produces all four (4) of the above type of polyethylene but it recommends Crosslink material for refuse containers for the longest proven service life (as described in their brochure).

Overall Ratings Based on Experienced Failure Levels

1. Rotational Molded High Density Crosslink
Best Process, Best Resin
Less than 1% Replacement Rate
2. Rotational Molded Linear Medium Density
Best Process, 2nd Best Resin
Less than 3% Replacement Rate
3. Blow Molded High Molecular Weight High Density
2nd Best Process, Least Best Resin
Between 3% and 10% Replacement Rate

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4. Injection Molded High Density
Least Best Process, Least Best Resin
Between 3% and 10% Replacement Rate

CHEMICAL RESISTANCE OF CROSSLINK VS. OTHER POLYETHYLENES

Crosslink polyethylene is the most chemically resistant material available for refuse containers. The ultra high molecular weight structure of crosslink enables it to resist chemical breakdown while when other polyethylene's are attacked by chemicals, their resin properties immediately begin to break down. Notice the extremely low ESCR (Environmental Stress Crack Resistance) of other polyethylene's as compared to Crosslink. (In Comparison of Different Resins)

These ESCR values involve soaking a stressed piece of polyethylene in a soap-like solution for a period of time. Imagine the results if these pieces were to come into contact with materials that might be thrown into a refuse container such as cleaning agents, nail polish paints, foods and even some industrial type wastes.

Phillips 66, a manufacturer of Crosslink High Density Polyethylene –CL200, performed the following test to demonstrate the outstanding environmental and thermal stress cracking resistance of Crosslink as compared to conventional High Density Polyethylene Rotational Molding resins.

Several two (2) Jerry cans molded from the different materials were filled $\frac{3}{4}$ full of gasoline. The cans were sealed and placed in an explosion proof hot room at 130 degrees F. The High Density Polyethylene Cans failed by stress cracking in three (3) days while none of the Crosslinked cans failed in two (2) years.

ADVANTAGES OF CROSSLINK

- Longer Product Life Cycles –Crosslinked high-density polyethylene refuse containers are experiencing service lives in excess of ten (10) years in all parts of the country. A longer part useful life translates to less material going to the landfills
- Source Reduction – The higher hoop stress values of crosslinked material means you can design parts with 10-15% less material per part, while maintaining equivalent strength, as compared to non-crosslinked materials.
- Source Generation – Crosslinked high-density polyethylene represents only 0.08% (0.0008) of the total polyethylene stream in a year.

RESIN PROPERTIES OF NON—CROSSLINKED POLYETHYLENES

The resin properties of non-crosslinked polyethylene are based on a natural non – color resin. When pigment (color) is added to these resins, their original resin properties are no longer the same. The addition of color significantly reduces their resin properties. The resin properties these suppliers boasted about are no longer in effect. The same is not true with Crosslink Polyethylene, which maintains its resin property with the addition of color.

RESIN PROPERTIES AS RELATED TO REFUSE

A refuse container plastic resin needs to have the highest ESCR value available as the breakdown in refuse containers comes from:

- Chemical Attack- Refuse ingredients such as food wastes, household chemical agents and hazardous chemicals.

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- Sunlight Degradation – Sunlight depletes the resin properties over time resulting in a progressively weaker container.
- Environmental Elements_ Intense heat or cold temperature fluctuations.

CONTAINER MOVEMENT

NOTE: It is not the normal usage of a container that causes its demise as a container remains stationary 99.93% of the time.

Consider the following time allocations:

There are 87,600 hours in a ten (10) year period.
The container is emptied 520 times in a ten-year period.

- 2 minutes each week to take the container to the street.
- 1 minute each week to empty the container.
- 2 minutes to bring the container back to its location.
- 2 minutes each week of opening and closing the lid.

Total of 7 minutes per week of movement.
7 minutes times 520 weeks of activity equals 60 hours.
 $60 \text{ hours} / 87,600 \text{ hours} = .0007 = \text{Total Moving Activity}$
 $87,540 \text{ hours} / 87,600 \text{ hours} = 99.93\% = \text{Total Stationary Activity.}$

RECYCLABILITY - REDUCE / RECYCLE / RECOVER

ROTO Industries, Inc. is actively committed to the concept of recycling. We fully utilize all of our by-products and blens through regranualizing process. We are in the process of recycling our cross-link polyethylene into other products such as bin lids and bin liners. Watch your trade journals for these exciting and groundbreaking announcements.

CROSSLINK POLYETHYLENE IS RECYCLABLE

Many refuse containers available on the market are advertised as one hundred percent (100%) recyclable. The product's material (High Density or Linear Low Polyethylene) can be melted down to a plastic that can be used in other plastic applications. The recycled product would not be suitable for applications where durability and strength are required as the recycled product does not have the same material properties as the virgin material. The recycled product's applications would be low durability products such as plastic non-food consumer bottles or as a "Filler" in virgin material

While Crosslink polyethylene is not recyclable as a melted down by-product, it is recyclable in the form of a reground additive. This places Crosslink in the same class as High and Low Density Polyethylene by-products at both are acting as "Fillers" to virgin material

The Crosslink material can be shredded and ground to a fine mesh and used as filler with virgin material to make new products such as roadside sound barriers, mud flaps for refuse trucks, and wheels for use on new rotational molded refuse containers.

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E.P.A. APPLAUDS CROSSLINK POLYETHYLENE

The inherent strength of Crosslink polyethylene contributes to its long-term usefulness. By not having to frequently replace Crosslinked refuse containers, they meet the highest criteria set by the Environmental Protections Agency (EPA), which is "Source Reductions." The fact that Crosslink is currently being recycled in new applications and not sent to the landfills enables it to meet the second EPA criteria, which is "Recyclability".

The issue of "Durable" versus "Disposable" must be addressed. Industry manufactures some products for short life spans while other products are built to last as long as possible. We don't recycle metals into our airplanes and automobiles as their product life span is projected into years, while recycling metal cans makes more sense as their life span is months.

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