

GUIDELINES FOR HANDLING AND USE OF PLASTICS DRUMS



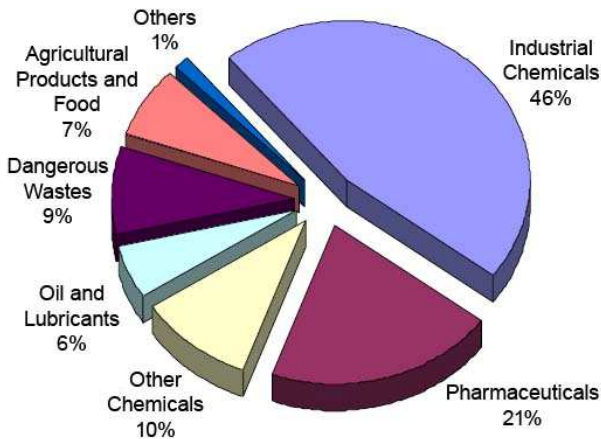
1 Introduction

Plastic materials have acquired a remarkable participation in worldwide markets of rigid containers for the most varied products for massive and industrial consumption.

Within the important market segment of rigid plastic containers, drums represent a 15% in the case of the American market, whilst in Venezuela participation is 4%.

As it has happened with plastic in different applications or uses of rigid containers, the demand for drums has shown a sustained growth during the last two decades. As an illustration, during the 90s, the share of these materials in the American market grew a 5%; in this term, the participation of metal drums decreased a 10% (a relative difference of 15%).

Share in the American Plastic Drums Market (2000)



As evidenced in the graphic, plastic drums are used in a wide variety of industrial applications.

Polyethylene offers an excellent combination of easiness in processing, chemical resistance, thermal stability, resistance to environmental factors (light,

humidity, heat), and costs, thus enhancing its market dominance.

In qualitative terms Polyethylene drums have an advantage over the metal drums in several aspects.

Comparative Aspect	Polyethylene	Metal
Manufacture Power	*	8
Vertical Stocking	*	*
Horizontal Stocking	(Up to 4 piles with special designs)	(Up to 4 piles)
Recycling	(price in recovered market)	**
Oxidation / Corrosion	*	8
Weight	(9.5 – 12.5 kg)	(12 – 14 kg)
Brightness	*	*
Durability	**	*
Comparative Aspect	Polyethylene	Metal
Color	*	*
Chemical Resistance	*** (High resistance to acids, alkali, and polar solvents)	* (Superior resistance to Surfactants)
Vacuum Sealing	*	*
Impact Resistance	*** (Recovers greatly from deformation)	8 (Experience deformations that might cause losses)
Decoration Environment Resistance	* (Products with UV)	** (Corrosion is probably)
Handling	*	**
Fire Safety	(Minor ign. temperature. PE is not self extinguish. This attribute can be reached with additives. Its softening point dec. risks of explosions due to heat exposure)	(High ignition temperature, no volatiles included. Better resistance to spills in external fires. Softening point increases risk to explosion due to heat exposure)
Versatility	**	*
Grade of Immunity	*	*

* Enhanced attribute or strength of the product

* Remarkable

** Outstanding

*** Excellent

8 Represents a negative attribute or weakness of the product.

GUIDELINES FOR HANDLING AND USE OF PLASTICS DRUMS



Polyethylene Drums

(Efficient and Safe Packaging for your Products)

2 Materials

Polyethylene drums may be manufactured with high and medium density lineal products (PEAD and PEMD respectively). Depending on the transformation process to use, Polinter recommends the following products:

Property	Venelene® 8504UV8D	Venelene® 7700B
Density (Kg/m ³)	938	950
MFI (dg/min)	1,90	0,045
ESCR (h) *	24	>1000
Transformation Process	Rotomolding	Blow Molding Extrusion

Both resins are especially designed for the manufacture of drums that will store aggressive chemical substances.

Venelene® 8504UV8D product includes a package set of additives especially formulated for the protection of the material during processing, as well as the environmental factors (UV sunlight radiation, heat and humidity).

Venelene® 7250B incorporates a package of anti-oxidants formulated for the protection of resin during its transformation stage. Polinter may incorporate the required UV protection additives in those cases in which the grade requirements justify so.

3 Substances to be stored in PE drums

The variety of substances that may be stored in Polyethylene drums, tanks and containers is much wider than the one for metal containers. In order to know the chemical compatibility existent between the Polyethylene and the substance to store

constitutes the first step to set forth the suitability of use for plastic drums. In general terms, Polyethylene is very resistant to the following effects:

- Inorganic Substances (acids and alkali)
- Organic solvents at room temperature (25 °C or less)
- Polar solvents such as: water, ketenes, alcohol, acids, esters.



Given its molecular structure, the Polyethylene is susceptible to suffer the effects of different chemical attack processes:

1. *ESC (Environmental Stress Cracking)*. Surfactants (soaps, organic acids, etc.) in presence of mechanical efforts tend to induce the formation and speed the growth of cracks in PE parts. Extended exposure to these substances under the sustained presence of external loads will finally cause the failure of the piece. Venelene® Polyethylene used for the manufacture of drums, tanks and containers is designed for having a high resistance to surfactants; however, before storing these substances it is recommended to perform lab

GUIDELINES FOR HANDLING AND USE OF PLASTICS DRUMS



tests that could determine the convenience of the container.

2. *Meltdown – Dissolution:* Substances such as benzene, aromatic hydrocarbons and chlorinated hydrocarbons tend to be absorbed by PE, thus producing softening and swelling of the material. This process is the primary phase of dissolution and is known as Meltdown. Although such effect may be apparently mild, the softening of the material can reduce its resistance to piling and the loss of dimensional stability of the container.
3. *Oxidation:* Oxidants are the only known chemical substances that produce the degradation of the PE molecule. The effect of oxidant substances on PE is exhibited in a gradual form, therefore cannot be perceived in a short-term. The main PE oxidizing substances are:
 - Smoking nitric acid.
 - Smoking sulphuric acid.
 - Heavy Water
 - Chlorate Gas (Humid)
 - Liquid Bromine

Attached to this guide you will find a detailed chart in which the chemical resistance to several substances is shown.

4 Internal and External Finishing

Given their chemical resistance, plastic drums do not require of internal coatings. In case that the surface requires more chemical resistance to a determined substance or a low extraction level of additives incorporated to the polymer, it can be used dual layered drums, comprised by different plastic materials or different polyethylene formulations.

The external finishing of drums is determined by the surface of the mold; therefore it is possible to obtain drums with the most varied textures, although the most common feature is the sandblasting industrial finishing.

From the point of view of external decoration, Polyethylene can be colored, labeled or stamped in order to fulfill the most demanding aesthetic requirements. Differing from metal drums, Polyethylene drums coloring cannot be removed by mechanic means (scrapping, abrasion, etc) or chemicals, which guarantees that can exhibit better appearance even under the most severe handling conditions.



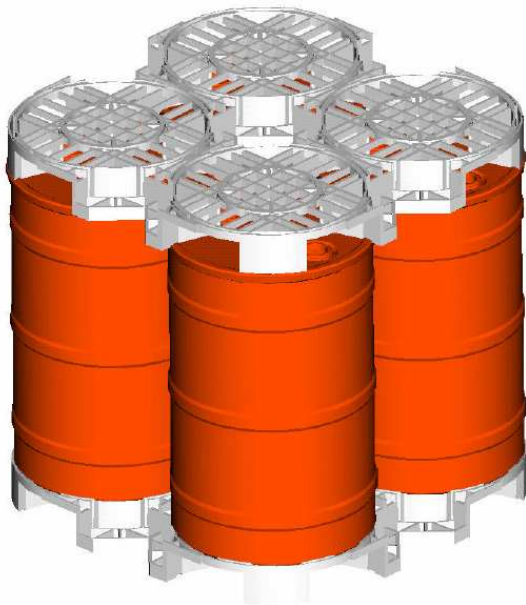
5 Storage and Use conditions

PE drums manufactured with Venelene® products can be stockpiled either horizontally or vertically, under the following conditions:

GUIDELINES FOR HANDLING AND USE OF PLASTICS DRUMS



- Vertical: four piles of palletized drums. In order to warrant an optimal performance in stockpiling, as well as simplify transport and handling operations of drums in warehouses, it is recommended the use of plastic racks for drums. These racks have plain surfaces and geometries that simplify the centering and thus optimizing the operation of the drum. In this way, the minimal surface dimensions of the rack must be 1.2m wide and 1.2m long. Wooden racks must be made with planks with the same thickness and width, in order to avoid the concentration of loads in determined drum zones. The piling of four piles must be made following the correct alignment of the column of drums; otherwise the piled height must be reduced to three or two piles.



- Horizontal: Drums with cylindrical designs can be horizontally piled in two pile configuration. The use of drums with reinforcement elements in the walls or polyhedral geometries can be horizontally stacked in configurations with a larger number of piles.



In order that users can count with a proper performance in storage and use of PE drums, they must corroborate that the manufacture thereof feature the following criteria:

- a.- Rotomolded Drums:
 - Minimum wall thickness: 4.5 mm
 - Material: PEHD (Medium Density Polyethylene) with a density equal or above to 936 k/m^3 , 100% virgin.
- b.- Blown Drums:
 - Minimum wall thickness: 4.0 mm
 - Material: PEAD (High Density Polyethylene) with a density equal or above to 953 k/m^3 , 85 to 100% virgin.

The maximum storage time is conditioned by the substance to be contained in the drums:

- I. Inert substances for PE: No restrictions. It is suggested not to extend from 9 month periods under extreme stockpiling conditions.
- II. Promoter agents due to ESC or Meltdown: there must be carried out performance tests in order to establish this period. As a general rule, it is not recommendable to exceed more than 3 months of storage.

PE manufactured drums, either in high or medium density, exhibit a better resistance to impact than metal drums.

PE drums can endure falls from a 1.5 meter height without exhibiting cracks that would cause the lost of vacuum sealing of the drum. Moreover, the capability of plastic recuperation of PE drums makes that a large percentage of the deformation suffered

GUIDELINES FOR HANDLING AND USE OF PLASTICS DRUMS



during an impact to be reverted and in contrast to the metal counterpart, they may be used again without large effects on their functionality.

6 Standards for the quality certification of drums.

International quality standards allow to both manufacturers and users to use a coherent base to define specifications and acceptance criteria or refusal of plastic drums.

Therefore, drum manufacturers must warrant that their product complies with the corresponding use requirements, whereby satisfying the acceptance limits of the respective norms for its approval: impact due to free falls, stockpiling and spills.



Drum manufacturers will be unable to warrant the functionality of drums in case that the stockpiling is made without following the recommendations described in the foregoing section "Storage and Use conditions".

Furthermore, it is necessary that both drum manufacturers and users perform the tests that determine the compatibility of the product to be stored in PE. Especially those cases in which the chemical resistance guidelines indicate that PE performance may vary with the product, the solubility of the product or ESCR.

Herein below there is a brief description of the main standards for design and certification on the quality of plastic drums:

Drum features	ASTM D5998. Standard Specification for Molded Polyethylene Shipping and Storage Drums.
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This standard encompasses government provisions of the United States set forth in the CFR (Code Federal Regulations) and NSF standards (National Sanitation Foundation International), regarding dimensions, design, construction and performance of drums.

About the relative aspects to the performance of drums, standard ASTM D5998 describe the evaluation methods for properties such as:

1. Resistance to impacts (Standard 49 CFR 178.603)
2. Leak test (Standard 49 CFR 178.604).
3. Hydrostatic Test (Standard 49 CFR 178.605)
4. Resistance to Stockpiling (Standard 49 CFR 178.606)

Drum features	U.N. Recommendations.
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United Nations' recommendations are not regulations but suggestions focused on the international transportation of hazardous materials by sea, air and ground. These recommendations are the base of international regulations, such as the International Maritime Organization IMO and the International Civil Aviation Organization (ICAO). They are also the base of the domestic transport standards, including the Hazardous Materials Regulations, HMR of the United States of America.

GUIDELINES FOR HANDLING AND USE OF PLASTICS DRUMS



UN recommendations for the transportation of hazardous materials are oriented to the following areas:

1. Listing of hazardous Materials (Identification and Classification)
2. Consignation procedures (labeling, marking and transport documentation)
3. Packaging procedures (quality tests and certifications).
4. Standards for containers (tanks, quality tests and certifications)

The tests recommended by United Nations for plastic drums include: Free Fall Resistance to Impact; Sealability and Hydrostatic Resistance.

ESCR	ASTM D5571. Standard Test Method for Environmental Stress Crack Resistance (ESCR) of Plastic Tighthed Drums not Exceeding 60 Gal (227 l) in rated capacity.
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This test consists on the measurement of the resistance of plastic drums to the exposure of substances that in presence of mechanical loads are able to induce a failure.

The standard indicates two procedures:

- Procedure A: It is exposed a minimum of three drums full (to a 10% of their capacity) to the action of a surfactant agent (inside the drum), to an elevated internal pressure of 2.0 ± 0.1 psi ($13.8 \pm 1,4$ KPa) and a temperature of 50 °C during 14 days or a specified period of time by the user of the drum, according to their needs.
- Procedure B: It is exposed a minimum of three drums wholly filled with a surfactant agent (inside the drum), to the action of a load applied on the upper part of the drum (previously sealed). For 208-liter drums, the load to be applied is 1100 lb (499 kg). The duration of the test is 14 days, or a time specified by the users of the drum, according to their needs.

This bulletin has been elaborated by the Marketing Management of Polinter, with the support of specialists of Investigación y Desarrollo, C.A. (INDESCA), and the Technical Services Management of CORAMER. It is intended to all the users of Venelene resins and we trust that the information herein contained will be useful.

In case of comments or suggestions, please write to info@polinter.com.ve or contact our Commercial Agent at <http://www.coramer.com>

The information described in this document is, to our best knowledge, accurate and truthful. However, since the particular uses and transformation conditions are completely out of our hands, the adjustment of the parameters in order to reach the maximum performance of our products for a specific application depends on and is the responsibility of the user.

For further information on safety features and the handling and disposal of our products, please consult the Safety Data Sheet (MSDS) of Venelene Polyethylene.