Polyethylene Pipe for Pasture Pipeline Applications



Polyethylene is often a popular pipe material for use in pasture pipeline applications. There are many different types of polyethylene pipe available, and selection of the most appropriate piping material will depend on the nature of application, as well as the cost of the material.

What is Polyethylene?

Polyethylene is one member of a group of plastics known as Thermoplastics (plastic materials that can be re-melted upon the application of heat). The solid state of thermoplastics is the result of physical forces that immobilize polymer chains and prevent them from slipping past each other. When heat is applied, these forces weaken and allow the material to soften or melt. Upon cooling, the molecular chains stop slipping and are held firmly against each other in the solid state. Thermoplastics can be shaped during the molten phase of the resin and therefore can be extruded or molded into a variety of shapes, such as pipe flanges or valves.

Like other plastics, polyethylene is a solid material that contains one or more polymeric substances which can be shaped by flow. A polyethylene pipe compound consists of polyethylene resin combined with colorants, stabilizers, anti-oxidants or other ingredients which protect and enhance properties during fabrication and service.

What is the difference between High, Medium and Low Density Polyethylene?

Three characteristics of polyethylene resins are usually used to classify the properties of the final product: density, molecular weight, and molecular weight distribution. Of these properties, only density is usually considered by the user of PE pipe.

PE pipe was originally manufactured using only one process that resulted in a material that would currently be classed as low density. As time passed and polyethylenes with varying properties were produced through a variety of processes, there arose a need for an industry standard that would classify the resin according to density. The American Society for Testing of Materials (ASTM) established the following classification system, still in use today. It is a part of ASTM D1248, *Standard Specification for Polyethylene Plastics Molding and Extrusion Materials* [2,5].

TYPE	DENSITY
I	0.910-0.925 (low)
II	0.926 - 0.940 (medium)
III	0.941-0.959 (high)
IV	0.960 and above (high homopolymer)

The table on the following page indicates how various other important properties of PE material vary with density:

Material Property	Change in Material Property as Density Increases	Implications for Pasture Pipeline Application
Tensile strength	⇑ **increasing**	LDPE is better suited to lower pressure applications (<80 psi). Higher pressure applications should use HDPE.
Stiffness	⇑ **increasing**	Higher density pipe is stiffer, therefore more awkward to handle, less flexible, less length on a coil. Higher hardness of HDPE means it is slightly more difficult to cut than LDPE.
Hardness	⇑ **increasing**	
Impact Strength	⇓ **decreasing**	LDPE is more resistant to sharp blows and some aspects of rough handling than HDPE.
Low Temp. Brittleness	⇑ **increasing**	
Abrasion Resistance	⇑ **increasing**	HDPE is more resistant to abrasion than LDPE, can tolerate being dragged around more.
Stress Crack Resistance	⇓ **decreasing**	The use of barbed insert fittings with HDPE generally not encouraged. LDPE more resistant than HDPE to periodic crushing.
Permeability	⇑ **increasing**	Generally not an issue in most pasture pipeline applications. However, if pipe is to be buried in soil contaminated with hydrocarbons, specialist advice should be sought.

What about the use of PE pipe for prolonged outdoor exposure?

Ultraviolet (UV) radiation and oxygen induce degradation in plastics that usually alter their physical and mechanical properties. The function of UV stabilizers is to inhibit the physical and chemical processes of UV-induced degradation. There are two separate issues when dealing with UV protection. The first is weatherability, which is defined as the capability of the resin to resist changes in the physical properties when exposed in an outdoor environment. The other parameter, which is often used to test the durability of a pigment system, is called color fastness, a measure of the time it takes for an article to fade or to change colors. Since all plastics are susceptible to attack by UV light, the first step is to protect the plastic resin by using a UV stabilizer, of which there are many different types on the market.

Carbon black is considered to be the best color for outdoor articles because of its powerful UV absorptivity. It is also the least expensive pigment for plastics since it is a colorant and, at the same time, one of the best UV stabilizers for outdoor plastic articles.

The Bigger Picture

Polyethylene is one of the most popular materials for pipe used in pasture pipeline applications. Generalizations regarding which kind of polyethylene is best for pasture pipeline applications are hard to make. Choices relating to the kind of PE pipe that would be most appropriate for a given application depend on the nature of the application (high or low pressure, buried or surface-laid, etc.), as well as the cost of the pipe and the required joining methods. In many pasture pipeline applications, LDPE pipe is chosen because the applications are relatively low-pressure situations, the pipe is often cheaper than HDPE pipe, it comes in larger coils, and it is easier to work with in that it is easier to cut, is more flexible, and requires less sophisticated fittings and joining methods.

Additional advice regarding which kind of material would be best suited to a given application should be sought from manufacturers and vendors. For additional information relating to the planning and development of pasture pipelines, as well as for additional information on livestock watering, refer to other Fact Sheets in this series, contact your local AAFC-PFRA office or call the toll-free telephone line at 1-800-667-7644.

Sources of information for this Fact Sheet include: *PPI Handbook of Polyethylene Pipe*, The Plastic Pipe Institute, http://plasticpipe.org/publications/pe_handbook.html; Specification Sheet, Polyethylene (PE) Plastic Pipe and Fittings for Water Service, http://www.ppfahome.org/pdf/pespec.pdf

UNIT ABBREVIATIONS

psi - pounds per square inch	kPa - kilopascal	gpm - gallon per minute
mm – millimetre	m - metre	ft - feet
in - inches	km - kilometre	L/s - litres per second

UNIT CONVERSIONS

1 US gallon = 3.785 litres	1 cubic metre (m^3) = 1,000 litres	1 metre (m) = 3.28 feet
1 Imperial Gallon = 4.546 litres	1 kilometre = 1,000 m = 0.62 miles	1 psi = 6.985 kPa
1 inch = 25.4 mm	1 psi = 2.307 ft. of water	

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Également disponible en français sous le titre *Canalisations de polyéthylène utilisées dans les pâturages*

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