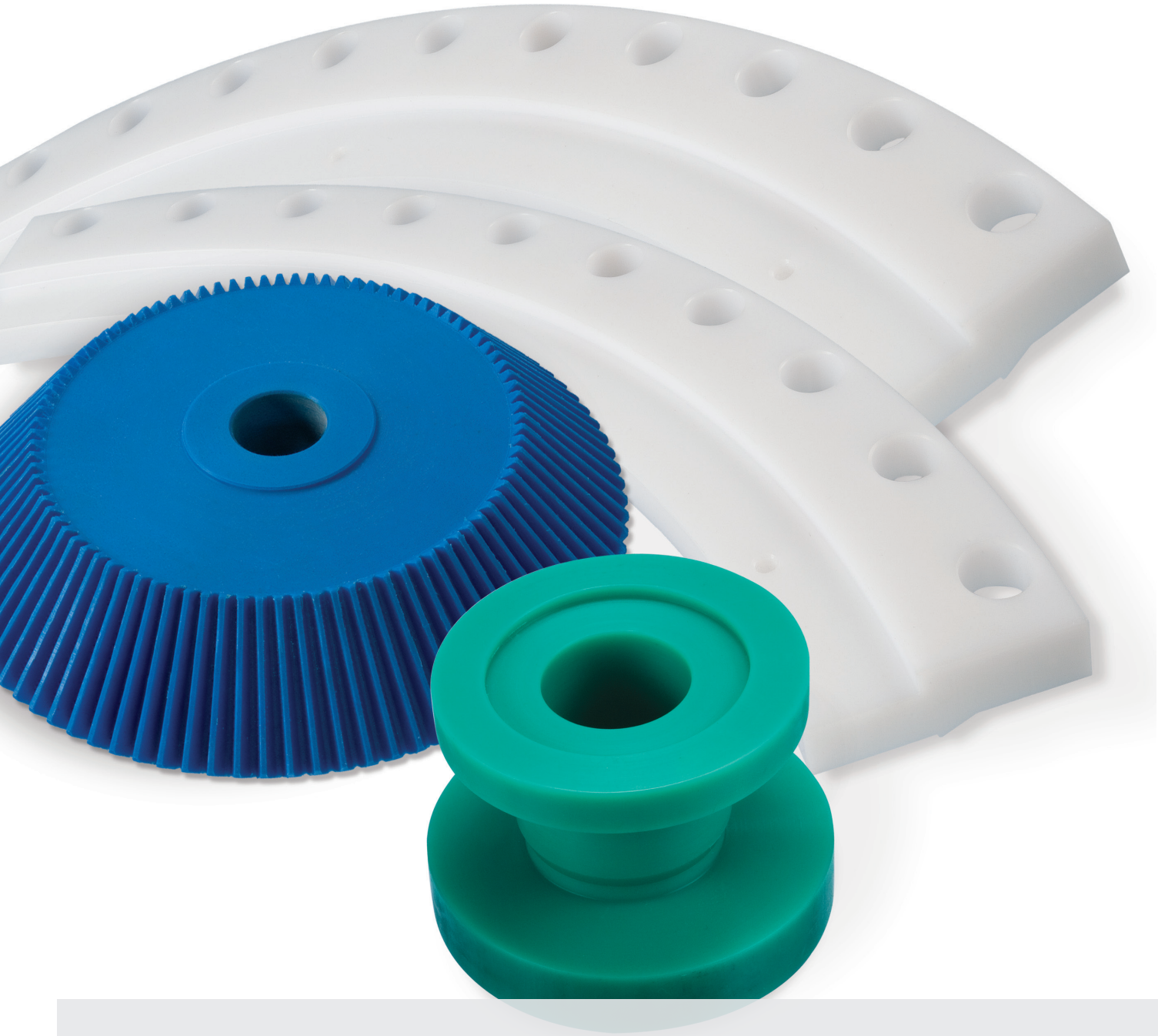
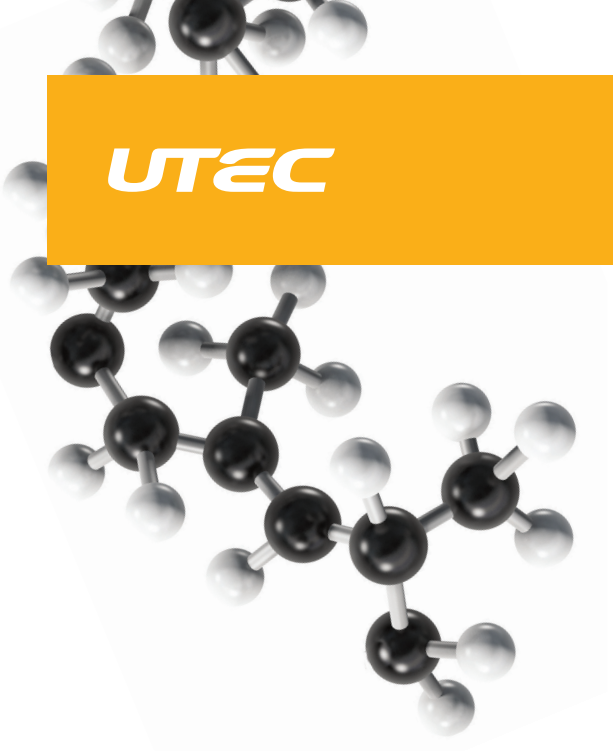


UTEC

Ultra High Molecular Weight Polyethylene (UHMWPE)

Braskem

UTEC



UTEC is the trade name of the Ultra High Molecular Weight Polyethylene (UHMWPE) developed and produced by Braskem with its own technology resources.
UTEC has a molecular weight about 10 times higher than High Density Polyethylene (HDPE) resins. The Ultra High Molecular Weight of UTEC results in excellent mechanical properties such as high abrasion resistance, impact strength and low coefficient of friction. These special properties allow the product to be used in several high performance applications.
UTEC is sold in powder form in grades that vary according to the molecular weight and the average particle size. The molecular weight may be in the low range (3 million g/mol), medium range (5 million g/mol) or high range (7 to 10 million g/mol). Products with these different molecular weights are available in small (average diameter around 130 µm) or large particle sizes (average diameter around 190 µm).

Characteristics

High impact strength

Low coefficient of friction

High abrasion resistance

Chemical resistance

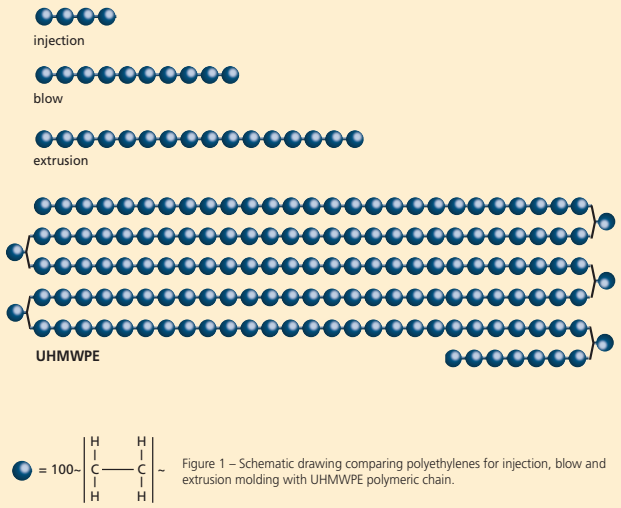
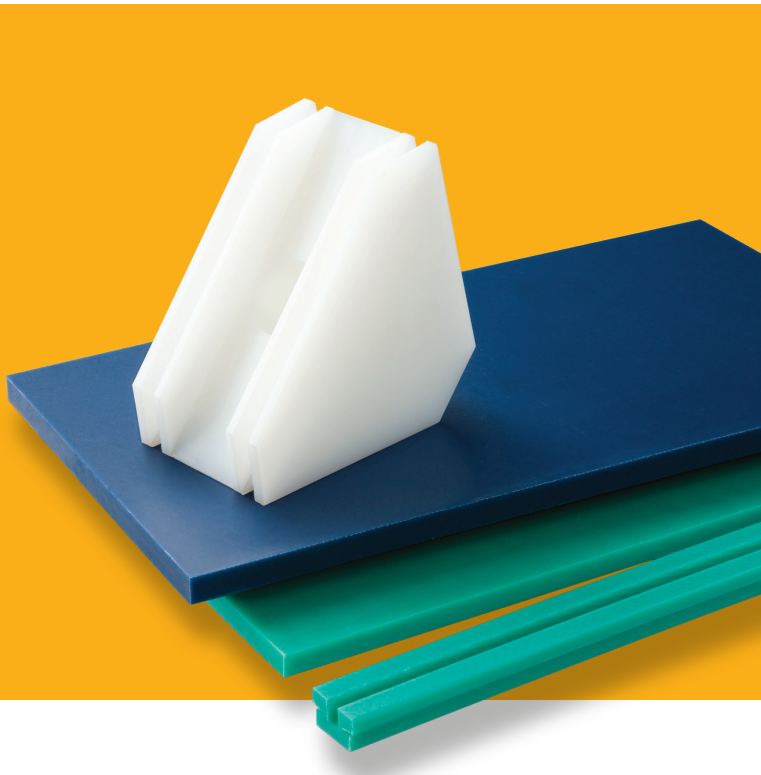


Figure 1 – Schematic drawing comparing polyethylenes for injection, blow and extrusion molding with UHMWPE polymeric chain.



Impact Strength

UTEC is the best solution because of its remarkable impact strength property when compared with other materials. Figure 2 compares the impact strength of the most important commodities resins and engineering plastics with UTEC.

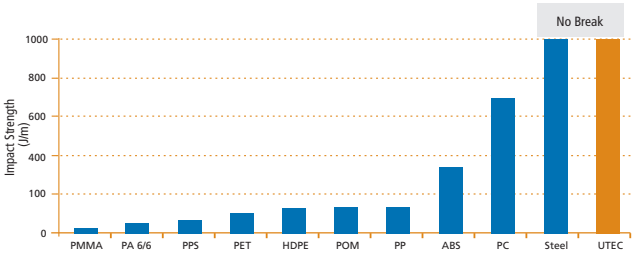


Figure 2 – Notched Izod Impact Strength (ASTM D 256): UTEC vs. other materials. Data source: HARPER, CHARLES A. Modern Plastics Handbook. 1999.

Coefficient of Friction

UTEC is an excellent material for sliding applications (low coefficient of friction), working as a self-lubricating material. Figure 3 compares the static and dynamic coefficient of friction of UTEC with other engineering thermoplastics, where it can be seen that, even without additives, UTEC is still the best cost/performance solution for sliding applications.

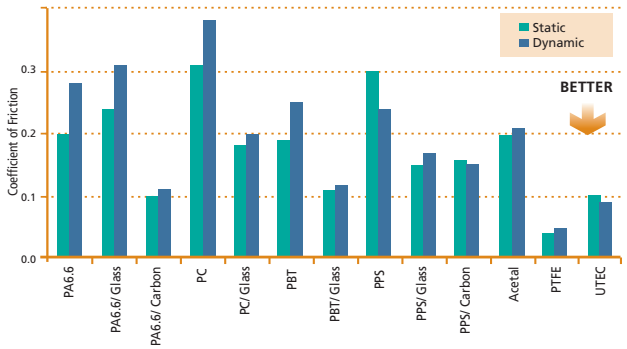


Figure 3 – Static and Dynamic Coefficient of Friction of UTEC and other materials. Data Source: CRAWFORD, R.J. Plastics Engineering. 3ª edição, 1998.

Abrasion Wear Resistance

Other outstanding UTEC property is its abrasion wear resistance. This makes UTEC suitable for replacing metals in applications that require high abrasion resistance and, besides that, UTEC parts are lighter than metal ones. Figure 4 compares UTEC with other materials used in high wear applications such as tubes, liners, silos, containers and other equipment.

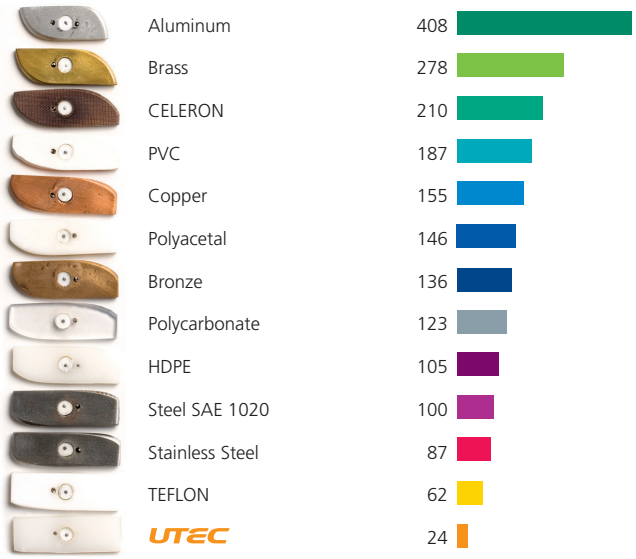


Figure 4 – Relative abrasion wear of UTEC grades and various materials, STEEL SAE 1020 = 100. The pictures show the tested parts. Measured by Braskem internal sand-slurry method.

In the UHMWPE technology, it is well-known that the abrasion wear decreases with molecular weight as can be seen in figure 5.

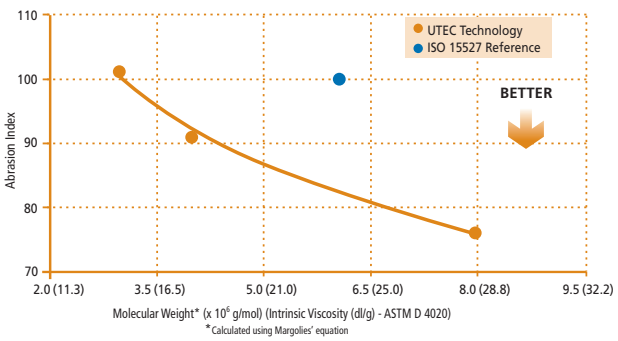


Figure 5 – Abrasion Index (Braskem internal sand slurry method) as a function of the Molecular Weight for the UTEC technology, measured according to ISO 15527 (ISO reference set as 100).

Chemical Resistance

UTEC is extremely resistant to a wide variety of substances. The material is almost totally inert, therefore it is used in the most corrosive or aggressive environments at moderate temperatures. Even at high temperatures, it is resistant to several solvents, except aromatic, halogenated hydrocarbons and strong oxidizing materials, such as nitric acid.
Compatibility tests between a product sample and the chemical environment are strongly recommended to verify satisfactory part performance, at the same conditions, for a period of time equal to the life time expected, at each new application. Even the substances classified with high attack or absorption frequently show good practical results.

Molecular Structure

The UTEC molecular structure has direct impact on its physical-thermal properties and processing performance. There are some characterization methods which can be used to measure the molecular weight of polymers. In the case of UHMWPE resins, the viscosity of polymer diluted solutions is widely used for that purpose. Figure 6 shows the typical UTEC technology MWD (Molecular Weight Distribution) curves measured by GPC (Gel Permeation Chromatography) method.

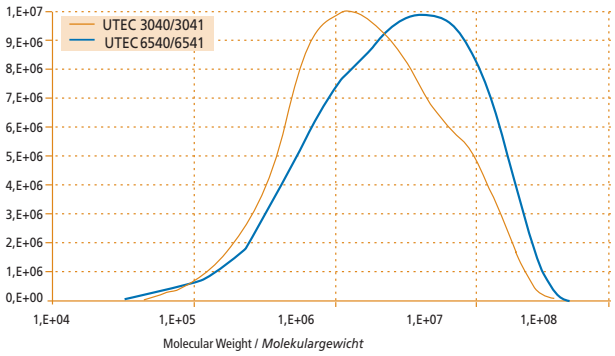
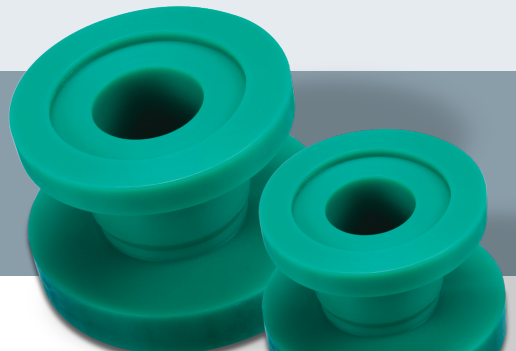


Figure 6 – UTEC Technology MWD curves.
Abbildung 6 - UTEC Technologie, MWD-Kurven

Additional Properties

- Elongational Viscosity x Molecular Weight
- Impact Strength x Temperature
- Stress x Strain
- Yield Stress x Temperature
- Specific Enthalpy x Temperature
- Specific Heat x Temperature

For more information, visit our portal
www.braskem.com.br/utec



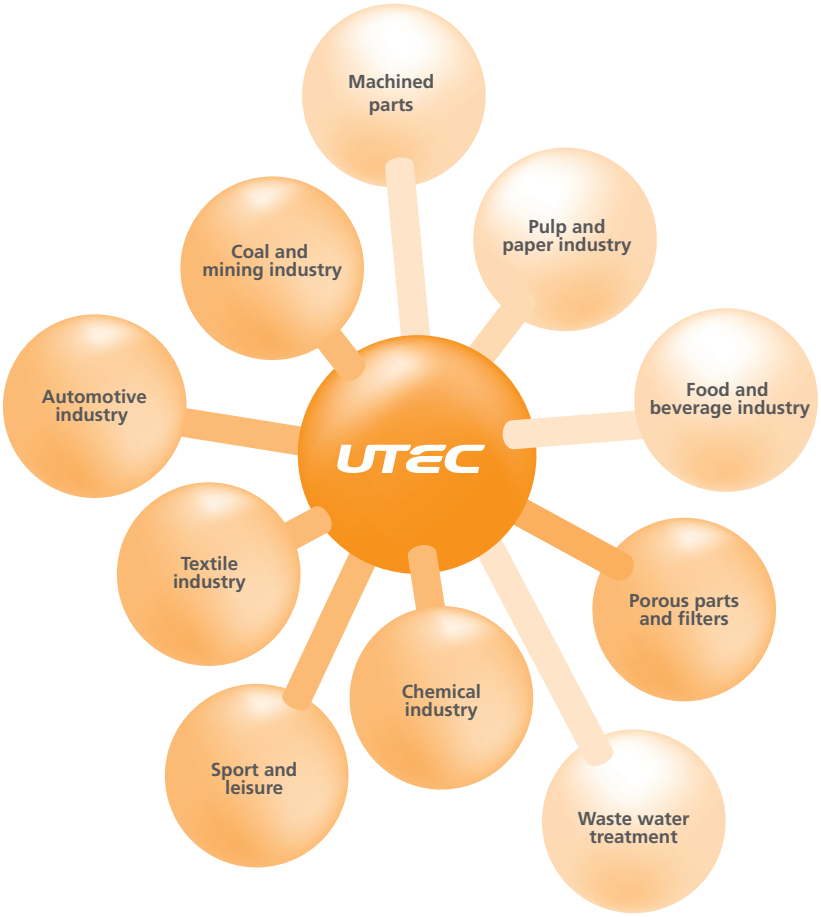
Processing

It is not possible to process UTEC through conventional methods such as injection, blow or extrusion molding, because this material does not flow even at temperatures above its melting point. It demands special processing techniques, being the most common RAM extrusion and compression molding. These processes are generally used to produce semi-finished parts such as rods and sheets. UTEC can also be sintered into porous parts (filters).

Those semi-finished parts can then be machined into parts for a wide range of applications. It is possible to use the same machining techniques as those used for wood or metal, such as sawing, milling, planing, drilling and turning. Other conversion processes may be used. By calendering of thin porous sheets battery separators for the automotive industry are produced.

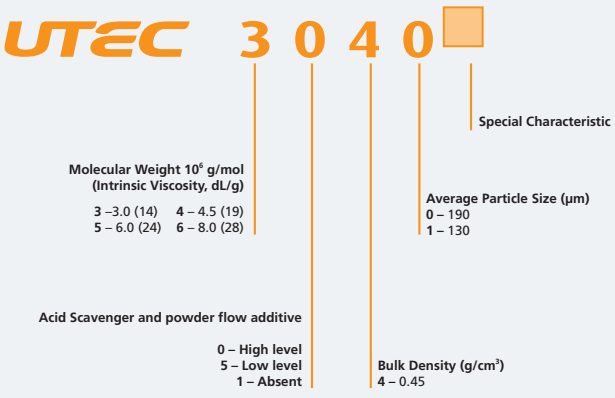
Applications

UTEC can be used in several applications such as:



Nomenclature

Here is an example of how UTEC products nomenclature is built:



Control Properties		Intrinsic Viscosity	Molecular Weight	Melt Flow Rate (190 °C/21,6 Kg)	Density	Average Particle Size D50	Tensile Strength at Yield	Tensile Strength at Break	Charpy Impact Strength [a]	Hardness (Shore D) (15 s)	Abrasion Index	Melt Temperature	Vicat Softening Temperature (50 N)
Method		ASTM D 4020	Braskem	ASTM D 1238	ASTM D 792	ASTM D 1921	ASTM D 638	ASTM D 638	ISO 11542-2	ASTM D 2240	Braskem (PE500=100)	ASTM D 3418	ASTM D 1525
Units		dl/g	g/mol	g/10 min	g/cm³	µm	MPa	MPa	kJ/m²	-	-	°C	°C
Braskem Idealis	**Idealis 500**	4.7	5,5x10⁵	0.70	0.951	195	> 20	> 30	> 50	63	80	136	80
		Braskem Idealis® 500 is the only High Molecular Weight Polyethylene resin in powder form specially designed for the compression molding process. Applications range from food handling cutting boards and playground toys to technical parts											

a) Calculated using Margolies' equation. b) Determined with double-notched specimens (14° v-notch on both sides) in accordance with ISO 11542-2.

Braskem

Control Properties		Intrinsic Viscosity	Molecular Weight [a]	Density	Average Particle Size D50	Tensile Strength at Break	Charpy Impact Strength [a]	Hardness (Shore D) (15s)	Abrasion Index (ISO 15527 reference set to 100)	Kinetic Friction Coefficient	Melt Temperature	Coefficient of Linear Thermal Expansion (between -30°C and 100 °C)	Specific Heat @ 23 °C	Specific Melt Enthalpy
Method		ASTM D 4020	Braskem	ASTM D 792	ASTM D 1921	ASTM D 638/ ISO 527	ISO 11542-2	ASTM D 2240/ ISO 868	Braskem (sand slurry method)	ASTM D 1894	ASTM D 3418	ASTM D 696	ASTM E 1269	ASTM D 3418
Units		dl/g	g/mol	g/cm³	µm	MPa	kJ/m²	-	-	-	°C	$°C^{-1}$	cal/g °C	cal/g
UTEC	**3040**	14	$3,0x10^6$	0.925	205	> 30	> 180	64	100	0.09	133	$1,5X10^{-4}$	0.48	0.34
		Applications which require high impact resistance - technical and porous parts, filters, compression molded sheets.												
	3041	14	$3,0x10^6$	0.925	150	> 30	> 180	64	100	0.09	133	$1,5X10^{-4}$	0.48	0.34
		Applications which require high impact resistance and use of pigments and/or additives - filters, technical and porous parts, compression molded sheets.												
	6540	28	$8,0x10^6$	0.925	205	> 30	> 100	64	76	0.09	133	$1,5X10^{-4}$	0.48	0.34
		Applications which require high impact resistance - technical and porous parts, filters, compression molded sheets.												
	6541	28	$8,0x10^6$	0.925	150	> 30	> 100	64	76	0.09	133	$1,5X10^{-4}$	0.48	0.34
		Applications which require high impact resistance and use of pigments and/or additives - filters, technical and porous parts, compression molded sheets.												

a) Calculated using Margolies' equation. b) Determined with double-notched specimens (14º v-notch on both sides) in accordance with ISO 11542-2. Braskem does not recommend the use of its products for manufacturing packages, pieces or any other type of product that will be used for storing of or be in contact with parenteral solutions or that will have any type of internal contact with the human body, except when explicitly indicated otherwise.

www.utec.com.br/en/

Braskem