IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 14, Issue 11, November 2024, ||Series -1|| PP 05-11

Analysis and selection of material for blister packs

Pham Duc Hung[1], Tran Thi Thu Hang[2]
[1](*College of Economics and Techniques Group 8, Thinh Dan ward, Thai Nguyen city, Viet Nam*)
[2](*College of Economics and Techniques Group 8, Thinh Dan ward, Thai Nguyen city, Viet Nam*)
Received 03 November 2024; Accepted 14 November 2024

Abstract:
Background:Plastic materials, currently there are many types of plastics that have been researched and applied in the details and components of machines and equipment from households to companies and factories such as computers, washing machines, cars, air conditioners, etc. The problem for designers and manufacturers of plastic parts that make up machines is to choose the right plastic material for each detail with specific uses in each type of machine or equipment. Designers and manufacturers can rely on the experience passed down from previous experts or from analysis and selection on theoretical documents. So this article provides some information and theoretical data as the basis for choosing the right material for plastic parts.
Materials and Methods: Each type of plastic material has properties such as mechanical properties, chemical properties, physical properties, thermal properties, electrical properties. Data on the properties of plastic materials are analyzed, compared and selected by designers and manufacturers to select the properties most suitable for the type of product and details, which is an important basis and a guarantee for choosing the type of material for plastic products and details.
Results: After comparing the properties of plastic materials, the author chooses plastic materials for plastic products such as pill blister packs.
Conclusion: The content of the article provides important data on the properties of different plastic materials, which is a reliable basis for plastic product designers to choose materials for other plastic products applied in practical life and production. At the same time, it is also the basis for calculating the design of plastic injection molds.
Key Word: Thermoplastics; Thermosetting Plastics; Plastic Properties; Selection of Plastic Materials.

I. Introduction

Plastic is a macromolecular chemical substance, a material extracted from petroleum, after being affected by heat and pressure, can be shaped. Most names of plastics have the prefix "poly-" which means polymer. Plastics are used for a variety of purposes from films, synthetic fibers, bottles, tubes, toys that we often use in daily life to high heat-resistant, high-hardness materials. The term plastics is derived from plasticity, meaning plasticity or flexibility. It is often used interchangeably with the term resin.

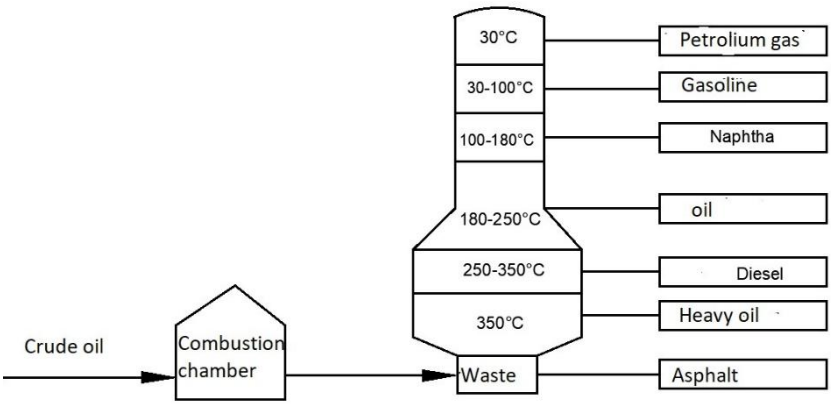


Figure 1. Diagram of the crystallization process of plastic.

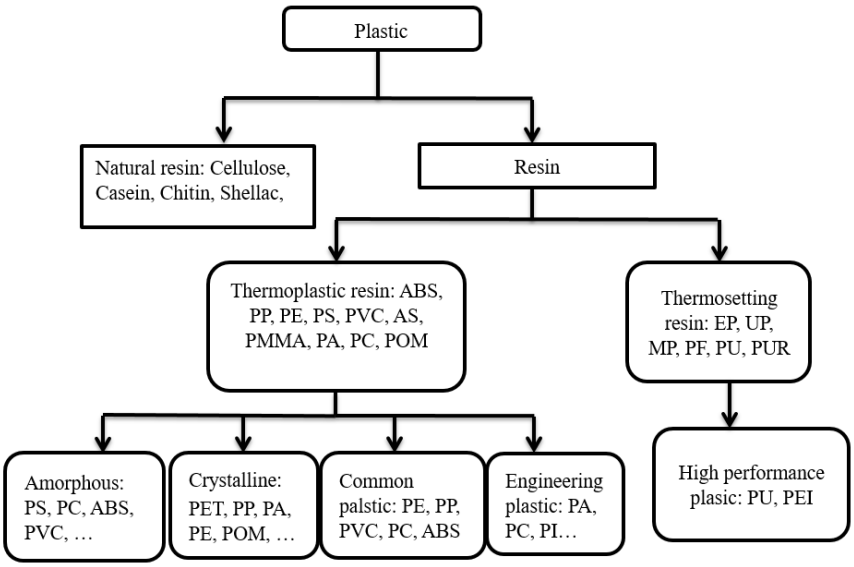
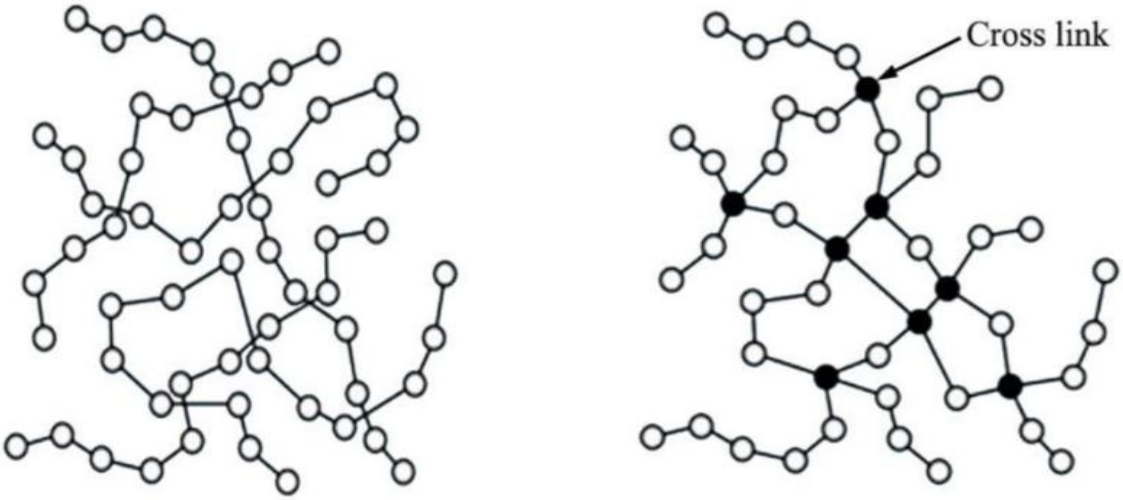


Figure 2. Plastic classification diagram.



Thermoplastic Thermosetting plastic

Figure 3. Crystal structure diagram.

II. Material and Methods

Applications of plastic products: Plastic products have many applications in life and production. Here are some common applications below.

Construction: Plastic is used in construction works such as flooring, insulation materials, and skylights12. Polycarbonate (PC) plastic has good light transmission, helping to save energy.

Household items: Products such as water bottles, food containers, and children's toys are often made from PET and PVC plastic.

Medical: Plastics are used to make medical equipment such as instrument trays, medical waste bins, and other components.

Agricultural: Plastics are used to make floors for barns, feeders for livestock, and other equipment.

Industrial: Plastics are used to make containers, pallets, and plastic trays in factories and warehouses. Plastics are a versatile and durable material that enhances efficiency and utility in many different areas.

Resin Name	Use	
Polyethylene (PE)	[Low density PE] Food, Drink, Drug container Packaging film Electric wire cover' Household goods, toys	[High density PE] Shopping bag, trash bag, detergent container water drain pipe, gas pipe
Polypropylene (PP)	Automobile interior or exterior parts Food wrapping film, Washing machine tub, Container Wardrobe box, chair, thin cups, dinnerware	
Polyvinyl chloride (PVC)	[Hard material PVC] Agriculture, water & drain pipe, electric wire pipe Architectural film for water tub, window frame Pipe joint, bulb	[Soft material PVC] Floor material, wall material, food wrapping, agricultural hose
Polystyrene (PS)	Clear container for food (HIPS) Parts for large home electric appliances such as TV, refrigerator, washing machine, air conditioner, Insulation material container	
Polycarbonate (PC)	PC, Printer, Facsimile, Cellular phone Optical disk such as CD and DVD Automobile head lump lens, meter board Carport, roof material, sound-proof construction material	
Acrylonitrile butadiene Styrene (ABS)	PC, Printer, facsimile, refrigerator, air-conditioner, vacuum cleaner, game machine, toy, sporting goods, leisure goods.	
Polyamide	Moving parts of machine (bearing, gear, cam, etc.)	

General properties of plastic products. The properties of plastics are divided into 5 types. The following types are all common types, because they are all dependent on humidity and temperature of use, so they need to respond to changes in environmental conditions.

Mechanical properties: Refer to the properties of mechanical changes that are destroyed or deformed due to the application of force (load) on plastic. Depends on the time of application of force, the magnitude of the force or the change in temperature. In addition, when plastics are used outdoors, heat will also be generated by ultraviolet rays.

Thermal properties: Including heat resistance and flammability. Thermoplastics generally have a larger coefficient of thermal expansion and flammability, and lower thermal conductivity or specific heat capacity than metals.

Chemical properties: These are chemical properties such as weather resistance due to changes in the external environment, stress cracking resistance, and resistance to chemicals. In the case of plastics coming into contact with chemicals, some changes will occur. In a stress-free state, after exposing the plastic to chemicals for about a week, check the changes in size, net weight, and appearance of the plastic.

Electrical properties: These are called electromagnetic properties, including insulation or conductivity, and electrostatic properties. Plastics have good electrical insulation properties, so they are widely used in the electrical field, but on the other hand. There is a disadvantage that plastics are easily charged.

Physical properties: These are physical properties such as density, optical properties (refractive index), moisture resistance.... The density of plastic is small, macromolecular properties and thermal properties.... Change depending on the mechanical treatment.

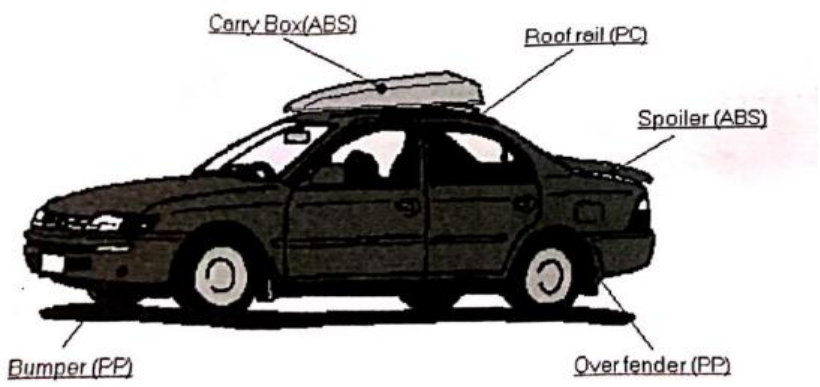


Figure 4. Some applications on cars.

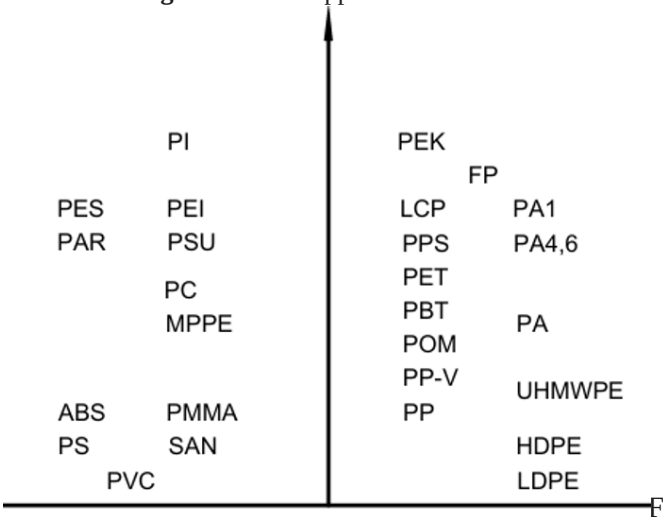


Figure 5. Price and features comparison chart of crystalline and amorphous plastics.

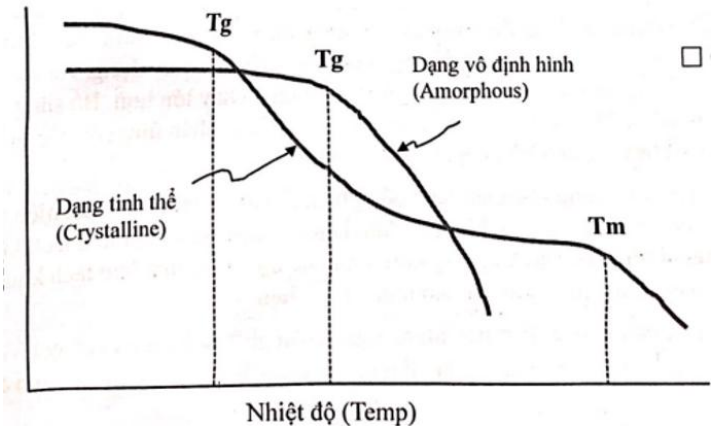


Figure 6. Temperature change chart of crystalline and amorphous plastics.

Property 1: Drying temparature – injection pressure.

Resin	Grade	Fillers	Name	Drying temparature (°C)	Drying time (hours)	Cylinder temperature(°C)	Mold temparature (°C)	Injection pressure
Acrylonitrile Butadiene (ABS)	High stiffness	-	ABS	70 - 80	2	180-260	40-80	560-1760
	Heat resistance	-	ABS	70 – 80	2	250-300	40-80	560-1760
	-	G/F 20-40%	ABS	70 - 80	2	200-600	40-80	1050-2810
Polypropylene (PP)	General	-	PP	-	-	180-300	20-90	600-1410
	-	G/F 40%	PP	-	-	200-300	20-90	703-1410
Polyethylene (E)	Low density	-	LDPE	-	-	150-270	20-60	500-2110
	Intermediate/ D	-	MDPE	-	-	200-300	10-60	562-2110
	High density	-	HDPE	-	-	200-300	10-80	600-1410
Polystyrene (PS)	General	-	GPPS	-	-	120-310	20-70	700-2110
	High impact	-	HIPS	-	-	190-280	10-80	703-2110
	Heat resistance	-	PS	-	-	190-280	20-80	703-2110
	--	G/F 20-30%	PS	-	-	170-280	20-80	1050-2810
Polyvinylchlorid (PVC)	Soft material	-	SPVC	-	-	140-190	10-60	562-1760
	Hard material	-	HPVC	-	-	170-210	10-60	703-2810

Table no 1: National Cholesterol Education ProgramNCEP ATP III goal**.**

Property 2: Elongation – Specific gravity.

Resin	Grade	Fillers	Name	Elongation (%)	Molding shrinkage (%)	Consecutive heat resistance (⁰C)	Thermal deflection temp (°C)	Specific gavity
Acrylonitrile Butadienne (ABS)	High stiffness	-	ABS	3 – 20	0.2 – 0.9	60 – 93	82 – 108	1.02-1.07
	Heat resistance	-	ABS	5 – 25	0.2 – 0.9	88 – 165	93 – 122	1.05-1.08
	-	G/F 20-40%	ABS	2.5 - 3	0.1 – 0.2	93 - 110	93 - 118	1.22-1.36
Polypropylene (PP)	General	-	PP	100 – 800	1 – 2.5	88 - 115	103 - 130	0.90-0.91
	-	G/F 40%	PP	2-4	0.2 – 1.8	121 - 138	110 – 161	1.22-1.23
Polyethylene (PE)	Low density	-	LDPE	90 – 800	1.5 – 5.0	80 - 100	37.6 – 49.2	0.91-0.925
	Intermediate/ D	-	MDPE	50 – 600	1.5 – 5.0	48.7 - 121	48.7 – 73.7	0.926-0.94
	High density	-	HDPE	20 - 130	2.0 – 6.0	78 – 124	59.8 - 88	0.941-0.965
Polystyrene (PS)	General	-	GPPS	1.6 – 4	0.2 – 0.7	60 - 80	74 – 110	1.03-1.09
	High impact	-	HIPS	13 – 50	0.2 – 0.8	59.8-82	72 – 104	1.03-1.06
	Heat resistance --	-	PS	2-60	0.2 – 0.6	-	-	1.05-1.09
		G/F 20-30%	PS	1-2	0.1-0.3	82-93	97-110	1.2-1.33
Polyvinyl chlorid (PVC)	Soft material	-	SPVC	200-450	1.0-5.0	-	-	1.35-1.6
		-	HPVC	40-80	0.1-0.5	54.2-105	57.0-82	

Table no 2 : National Cholesterol Education ProgramNCEP ATP III goal**.**

III. Result

Blister is a medical product, used to contain medicine, and to protect the medicine from being damaged during use and transportation. To ensure good product quality and the health of users, to protect the environment, it is often made of transparent and milky white plastic. Common types of plastic used in medicine.

Thermoplastic PVC (Polyvinyl Chloride): Advantages: High durability: Withstands impact well, less deformation. Good chemical resistance: Less affected by chemicals in medicine. Flexible: Can be easily shaped, suitable for many types of blister packs. Good protection: Protects medicine from dirt and bacteria. Non-toxic.

Disadvantages: Higher cost: Compared to PS.Additives are needed: To increase flexibility and reduce hardness.Poor biodegradability is not environmentally friendly.

PTE thermoplastic: Polyethylene Terephthalate (PET) is a thermoplastic resin belonging to the polyester group. It is synthesized from ethylene glycol and terephthalic acid monomers through the condensation process.

Advantages:High mechanical strength: PET has good resistance to force and impact.Gas and vapor permeability: PET is better at resisting O2 and CO2 than many other types of plastic. Food safety: PET is often used to make water bottles and food packaging because it is not harmful to health.

Disadvantages: High cost: More expensive than PVC. Difficult to process: The processing process is more complicated.
Thermoplastic PS.(Polystyrene): Advantages: Low cost: One of the cheapest types of plastic. Easy to process: Can be shaped quickly and easily. Transparent: Helps users easily observe the pill.
Disadvantages: Poor durability: Easily broken or deformed when subjected to strong force. Poor chemical resistance: Can be affected by some chemicals. Brittleness: Easily broken.
Technical requirements when choosing materials for blister packs.
Protection:
- Moisture resistance: The material must be moisture resistant to protect the medicine from damage due to moisture.
- Light resistance: Some medicines are sensitive to light, so the material must be UV resistant.b. Compatibility:
- Does not react with the medicine: The material must not react chemically with the ingredients of the medicine, ensuring that the properties of the medicine are not changed.
- Safety for users: The material must be safe and not harmful to the health of the user.
Mechanical strength:
- Good bearing capacity: The material needs to have high mechanical strength to protect the medicine from breaking or being damaged during transportation and use.
- Easy to process: The material must be easy to process and shape into blister packs with the desired size and shape.
Recyclability:
- Environmentally friendly: The material should be recyclable or biodegradable to minimize the impact on the environment.
- To ensure the above requirements, we choose PVC plastic material.

IV. Discussion

Selecting plastic materials with their important properties has helped design engineers have a database to design plastic injection molds to create plastic products. With data analysis of plastic flow on simulation software, engineers have chosen the most suitable plastic material. Therefore, the deeper direction of this article is to build a database on the software for quick analysis and help engineers choose effective plastic materials.

V. Conclusion

With the analysis and comparison based on traditional theoretical basis, it has helped the engineer design plastic products to choose suitable plastic materials and have a reliable basis for designing plastic parts to assemble into machinery and equipment.
The data of plastic properties as a basis for analysis, choosing the right plastic material for plastic parts is important and based on comparison charts, parameter tables, readers can analyze and choose the optimal type.

References

[1]. S.S. Storen *et al.* Localized Necking in Thin Sheets. J. Mech. Phys. Solids
[2]. B. Loret. On the Effects of Plastic Rotation in the Finite Deformation of Anisotropic Elastoplastic Materials
Mech. Mater.
[3]. D.J. Bamman. An Internal Variable Model of Viscoplasticity.
[4]. Y.F. Dafalia. The Plastic Spin Concept and a Simple Illustration of Its Role in Finite Plastic Transformations
Mech. Mater.
[5]. E.T. Onat. Flow of Kinematically Hardening Rigid-Plastic Materials
[6]. D. Walgraef *et al.* On the Formation and Stability of Dislocation Structures I, II, III. Int. J. Engng. Sci.
[7]. E.C. Aifantis. On the Dynamical Origin of Dislocation Patterns. Mater. Sci. Eng.
[8]. E.C. Aifanti. Mechanics of Microstructures I, II, III. E.C. AifantisMechanics of Microstructures I, II, III
[9]. P. Neuman. Strain Bursts and Coarse Slip During Cyclic Deformatio. Z. Metallkd.
[10]. J.J. Gilman. Micromechanics of Flow in Solids
[11]. A.M. Kosevich. Crystal Dislocations and the Theory of Elasticity. Cyclic Plasticity of Matrix and Persistent Slip Bands in Fatigued Metals
[12]. D.J. Bammann *et al.* On a Proposal for a Continuum with Microstructur. ActaMechanica