

Study the effect of adhesion promoter / energy modifier additives on application performance properties of Nylon/ABS

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ABSTRACT

It is often desirable to paint or otherwise coat automotive components, especially those of the exterior body, in order to decorate them or protect them from degradation in the face of sunlight, moisture, heat and cold. To achieve longer lasting and more durable parts, it is important for these coatings to tightly adhere to the surface of the components. ABS is taken in the ratio of 100%,0%,70% and PA610 in the ratio of 0%, 100%, 30%. The compounding of PA610 / ABS is carried out at twin screw extruder and injection molded standard test specimens are prepared. The results of mechanical and thermal properties, sample characterization and that of thermal has given better result for the blend of 70% ABS, 30% PA 610, 0.5% SMA, 1% Adhesion Promoter and 30% Glass fiber. This application is widely used for coating/paint of Automobile, Warning labels to industrial equipment. Finally it was shown that by using above mentioned materials to matrix higher mechanical and thermal properties has achieved.

Keywords: ABS, PA 610, glass fiber, Adhesion promoter, SMA, Injection molding and Twin screw extruder

1. Introduction

Plastics are used in wide variety of applications, including containers, household applications, and automobile parts items. In automotive industry, the use of plastics components has increased, over the past several decades. The quest for lighter, more fuel efficient cars has led automotive manufactures to utilize plastics in an increasing number of interior and exterior applications.

Automobile industry/other fields, the trend is to produce less expensive, lighter, and stronger components that appeal to the aesthetic tastes of the consumer. Appliance manufacturers produce units that have non-metallic casings and components that provide superior durability and function relative to their older counterparts.

Often, plastic materials will require coatings or markings to enhance their function or appeal. Designers and manufacturers of technical coatings routinely experience unique challenges when dealing with plastics due to their chemical and physical nature. This discussion will present concepts pertaining to the coating of plastics including the nature of plastic surfaces, wetting and adhesion promotion.

With increased awareness of these topics, the formulator of coatings for plastic materials will be better to design coatings having superior properties. Adhesion promoters or surface energy improve additives were synthesized, characterized through different analytical techniques and its effect was studied in ABS. These additives are to study by varying the concentration of these materials in 0.5%, 1.0% and 1.5% .

2. Materials, processing and experimental

ABS (Virgin-Natural-Extrusion), PA6,10 (Chembond), SMA (Kemylon Natural), E - Glass Fiber, Adhesion promoter (2000).

Materials formulation

SL.NO	ABS%	PA%	AP%	GF%	SMA%
1.	100	0	0	0	0
2.	100	0	0	30	0
3.	100	0	0.5	30	0
4.	100	0	1	30	0
5.	100	0	1.5	30	0
6.	0	100	0	0	0
7.	0	100	0	30	0
8.	0	100	0.5	30	0
9.	0	100	1	30	0
10.	0	100	1.5	30	0
11.	70	30	0	0	0.5
12.	70	30	0.5	0	0.5
13.	70	30	1	0	0.5
14.	70	30	1.5	0	0.5
15.	70	30	0	30	0.5
16.	70	30	0.5	30	0.5
17.	70	30	1	30	0.5
18.	70	30	1.5	30	0.5

Processing

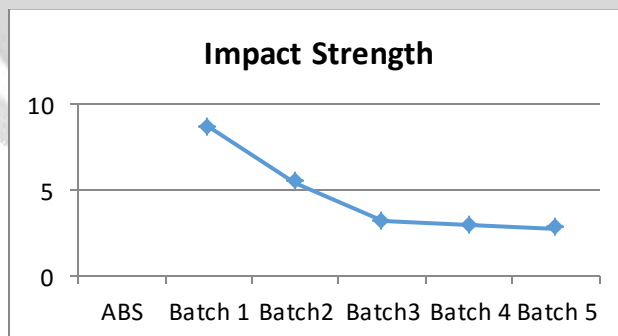
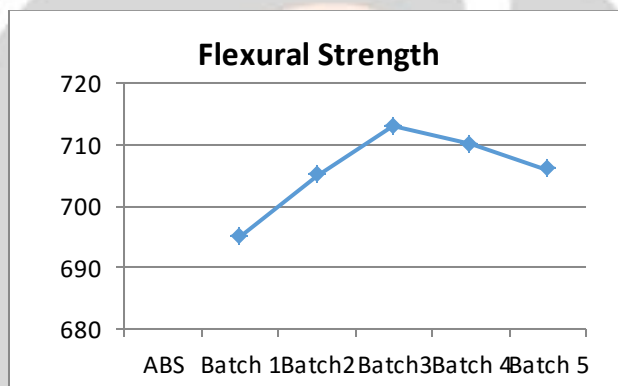
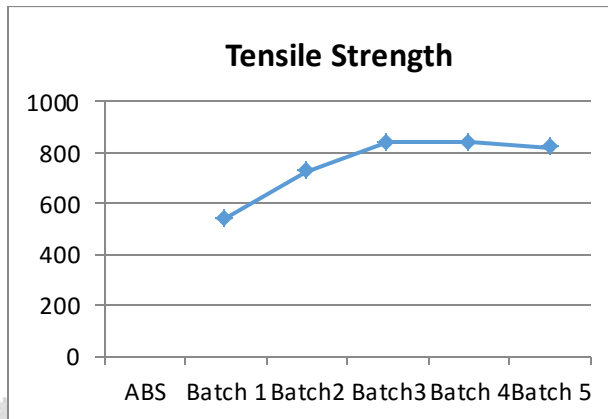
PA 610 and Impact modifier as an additive were compounded in Twin screw extruder at 220-235°c. Extruded material (PA610) is moulded in Injection moulding machine to take various specimens for mechanical and thermal properties.

General properties	Method	Unit	Values
MFI@230°C&2.16 kg	D1238	g/10 min	26
Density@25°C	D792	g/cm ³	1.066
Relative Viscosity @ 30°C,1% soln. In H2SO4	D789	-	2
Tensile Strength@ break,23°C,50mm/min	D638	Kg/cm ²	531
Flexural Strength@ break ,30°C,2 mm/min.	D790	Kg/cm ²	547
Impact Strength (Notched),23°C,2.75 Joule	D256	Kg-cm/cm	8.7
Rockwell hardness	D785	R scale	96

ABS, PA 610 (extruded pellets), SMA, E-glass fiber and adhesion promoter were compounded in twin screw extruder at 240-255°c.

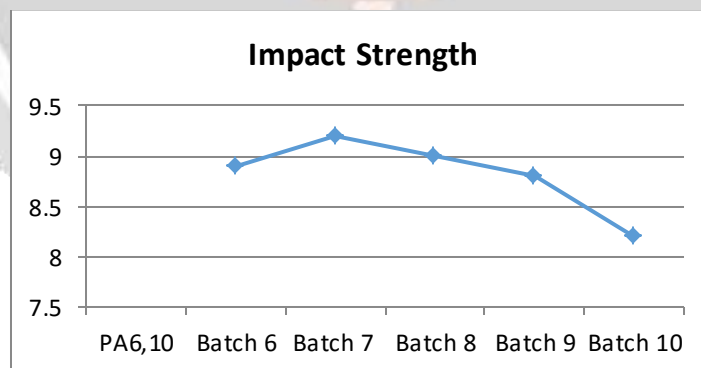
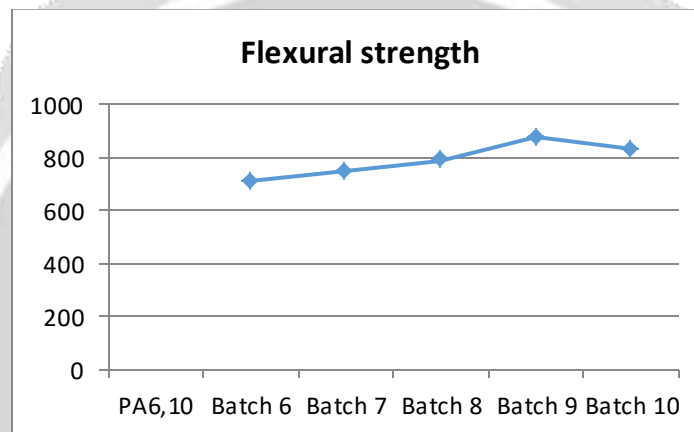
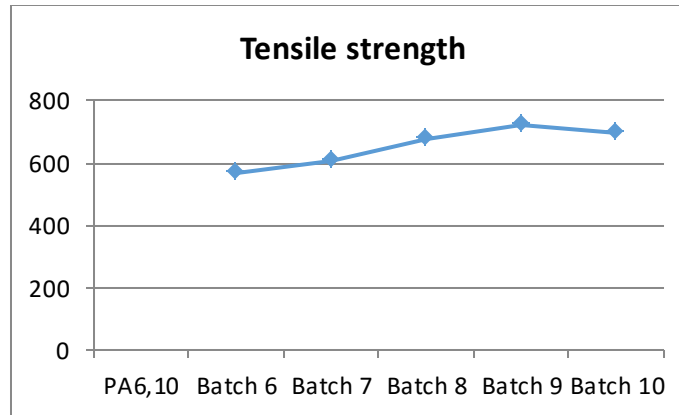
These compounded pellets are required to dry in oven at 85°c for 4 hours before prior to mold in injection molding machine. To mold various specimens for mechanical and thermal properties.

3. Results and discussions
Mechanical properties



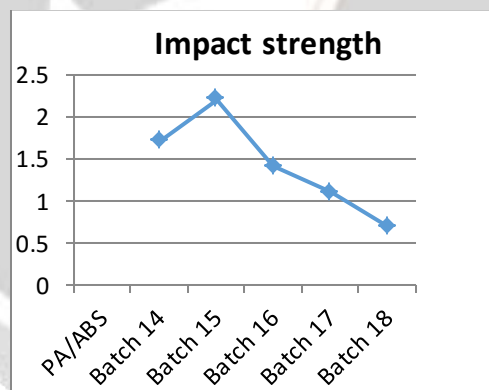
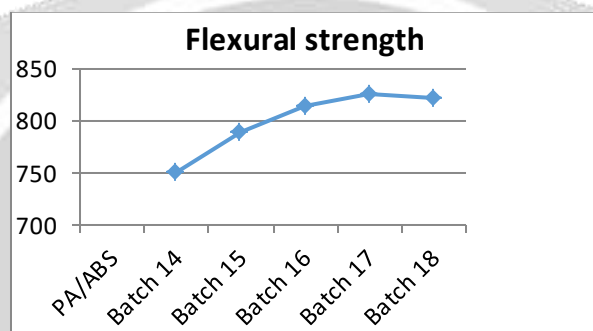
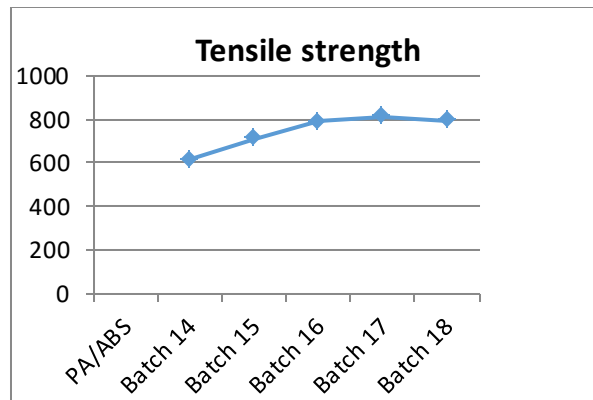
Above given **ABS mechanical properties** in the graph shows that Batch no 03 has given better tensile and flexural strength than other batches because variation of different materials ratio to the matrix. Impact strength is decreased due to glass fiber.

Whereas, **PA 610 mechanical properties** are given below.



PA 610, shows that there is increase in tensile as well flexural strength of batch no 09 than others. This occurs due to PA and other subtracts of materials, which is incorporated while compounding to enhance the mechanical properties. Whereas, Impact strength increase than decreases simultaneously due to ratio of glass fiber and other additives.

Last batches are blends of ABS/PA. Graphs are given below.

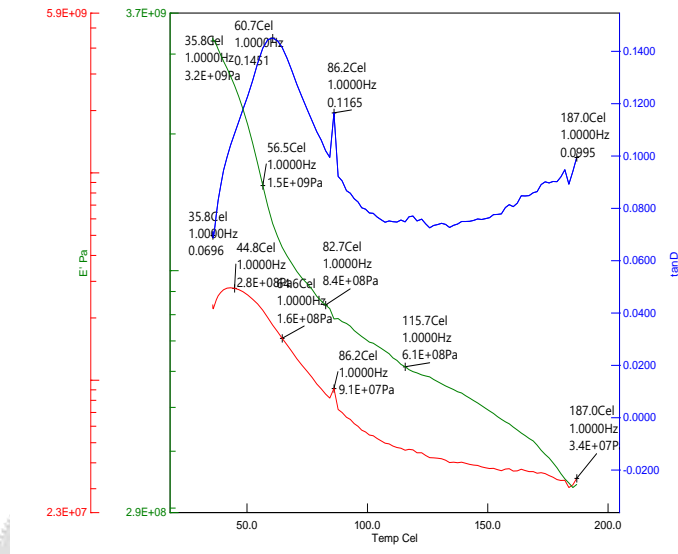


Above graph of ABS/PA shows that increase of tensile and flexural strength of batch no 17 than other batches due to better blends of matrixes, additives and adhesion promoter.

Thermal properties

DMA

Dynamic mechanical analysis (DMS) is a thermal analysis technique used to measure changes in the viscoelastic response of a material as a function of temperature, time or deformation frequency by subjecting it to a small oscillating force.



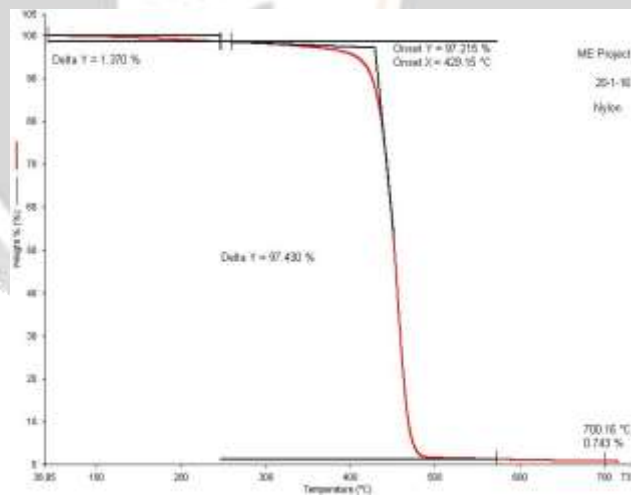
DMA shows that loss modulus loss its stored energy in the structure of polymer.

Tg also dramatically goes down in temperature.

Storage modulus has achieved optimized energy.

TGA

Thermogravimetric Analysis (TGA) is a test procedure in which changes in weight of a specimens are recorded as the specimen is heated in air or in a controlled atmosphere such as nitrogen.

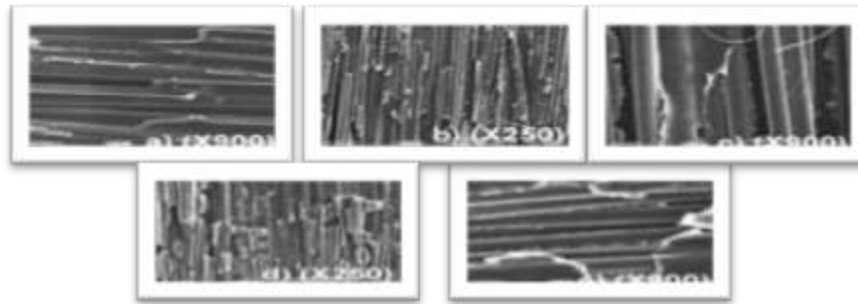


Above TGA shows single phase of ABS/PA610 hence we can approve that blends of ABS, PA, SMA, Glass fiber, additives and adhesion promoter have better homogeneous.

Morphological Properties

SEM

Scanning Electron Microscopy (SEM) is a one of the most versatile instrument for analyzing the microstructural characteristics of solid objects



SEM Test for batch no 3, 9, 15, 16 and 17

The above given pictorial of SEM show that figure A and B. ABS as matrix exhibit high degree of interfacial failure implying that the fibers were easily stripped from the matrix material. It means that the adhesion between fibers and ABS matrix is very poor.

Whereas, fig C and D, the ratio of PA 100% in the matrix displayed substantial degree of both matrix failure and interfacial.

However, fig E shows that matrix and fiber possess better interfacial bonding between ABS/PA hence, mechanical and thermal properties are very good as compare to other batches.

4. Conclusion

In summary, shows that blends of 70% ABS and 30% PA 610 along with 30% of glass fiber, 1% adhesion promoter and 0.5% SMA has achieved optimized results among others batches. Therefore, there is an improvement of mechanical and thermal properties.

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