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Effect of Egg Shell Powder and Fish Bone Powder Content on Mechanical Performance of PP

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Abstract - *In this project, binary blend PP/EPDM and tertiary blend PP/Egg shell powder/ Fish bone powder and binary blend PP/Egg shell powder and PP/ Fish bone powder has been prepared and studied. Effect of egg shell powder and fish bone powder content on mechanical performance of PP/ Egg shell powder/ Fish bone powder blend has been studied for binary blend and tertiary blend system by carrying out un-notched Izod impact and Tensile test Processing method has to be employed are filler and EPDM has to be mixed first and then melt blended with PP. Effect of addition egg shell powder and fish bone powder on mechanical performance of tertiary blend and binary blend has to be compared with tertiary blend of PP/EPDM/talc for varying composition Egg shell powder and fish bone powder with same composition of EPDM /. Thus polypropylene modified with EPDM and different fillers gives good balance between toughness and stiffness, thereby extending its end use application.*

***Keywords*: Egg shell powder, fish bone powder, Blends, PP,.**

1. INTRODUCTION:

The art of combining different materials in order to improve properties constituents one of the most ancient technologies is known to civilisation. This art has been applied for preparation of blend.

In the past two decades, polymer blend/alloy technology has achieved an important position in the field of polymer science. The earlier development in polymeric materials involved synthesis of new homopolymers and copolymers for tailoring properties. The realisation that new molecule do not always satisfy the desired properties and the blending can be employed more readily, has lead the commercial as well as scientific interest in blend technology.

In less than 10 years the commercial reach of alloys and blends has extended from only a few available products to worldwide recognition of the technology as a cost effective means of solving design problem and meeting changing specification. At present, the emphasis of the polymer science and technology is tending to move away from wholly new monomers, towards modification of existing one.

Polymer blends or alloys are mixtures of chemically different polymers and / or copolymers. They are mainly multiphase system with structure dependent on composite and processing condition. As the technology has expanded and diffused, the term alloy and blend have become almost interchangeable in plastic industry. Still by strict definition, there is difference, although the basic goal of each is identical which is to combine two or more polymers and thus make available the best properties of each component in a single functional material with an optimised balance of cost and performance, polymer alloys are class of poly-blends in which large interpretation of domains is secured by either chemical or physical means. Blends are a direct result of blending action and alloys are the final blends of well defined result of blending action and alloys are the final blends of well defined morphology and set of properties.

Purpose of blending

From polymer procedure point of view the development of new materials has long meant synthesis of new macromolecule. To develop the entirely new polymer, the producer has to go through difficult processes like carrying out research for finding out new monomer, developing the polymerisation process and ultimately producing the polymer on large scale, hence consuming a lot of the time and investment. In the context, polymer blending was essentially seen as a way of modifying properties of existing polymer so it is clear that developing new material by polymer blending means significant reduction in development cast, delays and flexibility in production.

It is not that by blending all the properties of both the polymers is going to increase. There are some losses in properties which may not be essential from the final application point of view.

The following material related reasons are often given in favour of polymer blending:

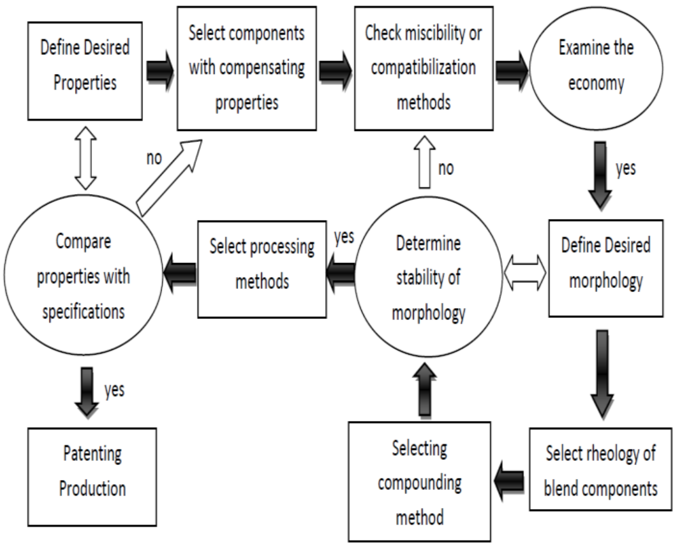
1. Developing materials with full set of desired properties.
2. Extending engineering resin performance by diluting them with low cost commodity polymers.
3. Improving a specific properties e.g. impact strength, Rigidity, Ductility, Chemical as well as Solvent resistance, Flammability, Gloss etc.
4. Adjusting the material performance to fit customer specifications at the lowest price.
5. Recycling industrial and/or municipal plastic waste.

The following advantages of blending are there for the product point of view:

1. Better processibility, thus improved product uniformity and scrap reduction.
2. Product tailoribility to specific customer needs, thus better customer satisfaction.
3. Quick formulation changes, thus plant flexibility and high productivity.
4. Blending reduces the number of grades that need to be manufactured and stored, thus saving space and capital investment.
5. Recyclability of blends achieved by control of morphology, thus improved economy.

Development of polymer blend with desired performance characteristics

Due to diversity of types and use of polymer alloys and blend it is impossible to provide a generally valid answer to the initial questions. However, it is eminently possible to propose a flow chart, a step diagram, which on one hand is general enough and on the other may prevent waste of time in search in dead alloys by the trial and error approach for the elusive goal for an ideal blend.



Algorithm:

Step 1: Define the physical and chemical properties the ideal blend should have.

Step 2: From a list of resin properties select those polymers which may provide some of the required behaviour. Usually a wider range of desired properties requires several types of potential candidates.

Step 3: Tabulate the advantages and disadvantages of the selected resins.

Step 4: From the list of candidates select a set of resins which assures the most suitable complementary properties.

Step 5: Determine the miscibility of the selected resin and for a method of making them compatible.

Step 6: Examine the economics, including cost of resin, compatible and compounding as well as the effect on farming maintenance and logetivity.

Step 7: Define the ideal morphology which will assure the optimum performance of the finished product.

Step 8: Select the rheological properties of blend component (M.W., compounding parameters etc) concentration of ingredients, amount of compatabilizers.

Step 9: Determine method of stabilization of morphology e.g. by controlled cooling rate, crystallization, chemical reaction, irradiation etc.

Step 10: Select the optimum fabrication method which will assure formation of final morphology.

Miscibility of blends

The relationship between blend properties of composition depends on the state of miscibility. Immiscible and partially miscible show multiple Tg. And each Tg is associated with separate amorphous phase. The majority phase tends to dominate thermal, chemical and non-facture related blend properties of the immiscible blends, while fracture related properties are largely controlled by the adhesion between phases.

Low adhesion between the phases in immiscible blends is quite common and responsible for the low strength and brittle behaviour shown by immiscible mixtures blends. Thus incorporation of compatabilizers serve as interfacial agents and adhesives. By contrast the non-fractured related properties of polyblends are often related in a nearly linear manner to the blend composition, although they may show variation caused by the loss of free volume which is accompanied by exothermic heat of mixing associated with forming miscible blend behaviour.

Successful implementation of multiphase, immiscible polymer blends depend on relation and for development of blend components to develop good mechanical ductility and strength. These properties require good interfacial adhesion.

Adhesion depends on:

1. Surface energies between phases.

2. Interpenetration by diffusion.

3. Segmental diffusion across the interface for this if required some mutual solubility.

Factors affecting polymer miscibility:

1. POLARITY:

Polymers that are similar in structure or, more generally, similar in polarity are less likely to repel each other and more likely to form miscible blends. Diverging polarities generally produce immiscibility.

2. SPECIFIC GROUP ATTRACTION:

Polymers that are drawn to each other by hydrogen bonding, acid-base, charge-transfer, ion-dipole, donor-acceptor adducts, or transition metal complexes are less common, but when such attractions occur they are very likely to produce miscibility.

3. MOLECULAR WEIGHT:

Lowest molecular weight permits greater randomization on mixing and therefore greater gain of entropy, which favours miscibility. More surprisingly, polymers of similar molecules weights are more miscible, while polymers of very different molecular weights may be immiscible, even if they both have the same composition.

4. RATIO:

Even though two polymers appear immiscible at a fairly equal ratio, it is quite possible that a small amount of one polymer may be soluble in a large amount of the other polymer, as understood in conventional phase rule. This consideration is extremely important in natural compatibility.

5. CRYSTALLINITY:

When a polymer crystallizes, it already forms a two-phase system, with important consequences for practical compatibility. In a polymer blend, when a polymer crystallizes, this adds another phase another phase to the system. If both polymers in a blend crystallize, they will usually form two separate crystalline phases, it is quite rare for the two polymers to co-crystallize in a single crystalline phase.

METHODS OF BLENDING

Preparation of polymer blend can be accomplished by:

1. **Melt mixing** (Most effective either single or twin screw extruder)

2. Solution mixing

3. Latex mixing

4. Powder mixing

5. Monomer and Polymer mixing

EXPERIMENTAL WORK PROPOSED:

Polymer blends comprise one of the most useful and interesting class of materials characterized by the intimate combination of two distinct phases. The most difficult task is development of materials with a full set of desired properties. This has been achieved by selecting blends components in such a way that the principal advantages of the first polymer will compensate for deficiencies of the second one and vice versa.

Polymer blends containing rubbers can be of 3 types

1. Thermoplastic Elastomer : Rubber content > 50 %

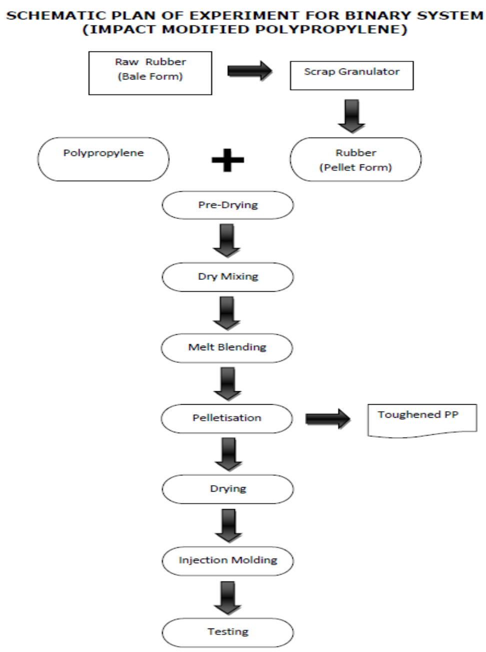
2. Thermoplastic Vulcanizates : Vulcanized rubber phase

3. Toughened Polymer or Impact Modified Polymer

In this experiment, we are focusing on Toughened Polymer or Impact Modified Polymer using EPDM as Elastomer along with Polymer Polypropylene.

The experimental work includes :

1. Preparation of PP/EPDM binary blend by varying percentage of EPDM from 10% to 20%.
2. Preparation of binary blends system by adding filler like fish bone powder and egg shell powder.
3. Preparation of secondary blend system by adding only fish bone powder.
4. Preparation of secondary blend system by adding only egg shell powder.
5. Comparison of properties of above prepared blend system.



Blend preparation:

1. Preparation of PP/EPDM blends by varying percentage of EPDM from 10% to 20%.

2. Preparation of PP/Egg Shell Powder blends by varying percentage of egg shell powder from 10% to 20%.

Batch No	PP Content		Egg Shell Powder Content	
	Wt %	Wt (gm)	Wt %	Wt (gm)
1	90	540	10	60
2	85	510	15	90
3	80	480	20	120

3. Preparation of PP/Fish Bone Powder blends by varying percentage of fish bone powder from 10% to 20%.

Batch No	PP Content		Fish Bone Powder Content	
	Wt %	Wt (gm)	Wt %	Wt gm
1	90	540	10	60
2	85	510	15	90
3	80	480	20	120

4. Preparation of PP/Fish Bone Powder/Egg Shell Powder blends by varying percentage of fish bone powder & egg shell powder from 10% to 20%.

Batch No	PP Content		Fish Bone Powder Content		Egg Shell Powder Content	
	Wt %	Wt (gm)	Wt %	Wt (gm)	Wt %	Wt (gm)
1	90	540	5	30	5	30
2	85	510	7.5	45	7.5	45
3	80	480	10	60	10	60

PREPARATION OF THE TESTING SAMPLES:

The blended pellets are pre-dried for removal of moisture that may be induced due to immediate quenching in water after extrusion process and stored.

Pre-heating Condition:

Temperature: 80 ± 5oC

Time: 2 hrs.

INJECTION MOLDING CONDTIONS:

Dumb-bell shaped specimen for Tensile testing and specimen for Izod Impact testing are prepared by SP180

Batch No.	PP Content		EPDM Content	
	Wt %	Wt (gm)	Wt %	Wt (gm)
1	90	540	10	60
2	85	510	15	90
3	80	480	20	120

Windsor Injection Moulding machine.

TESTING

1. **IMPACT STRENGTH:**

The Izod impact test has been carried out on injection moulded specimen specified by ASTM 4812 (ISO 180). Impact strength of all the specimens was recorded from Impact Testing Machine. The hammer used was of 0-10 Joules. Impact strength values are reported in Joules/m.

2. **TENSILE STRENTH:**

The tensile strength specimens which were obtained from injection-moulding were used for the test. The tensile strength and % elongation at break of the samples were evaluated according to the ASTM D638.

3. **SPECIFIC GRAVITY:**

The specific gravity was carried out as specified by ASTM 792 (ISO 1183).

RESULTS:-

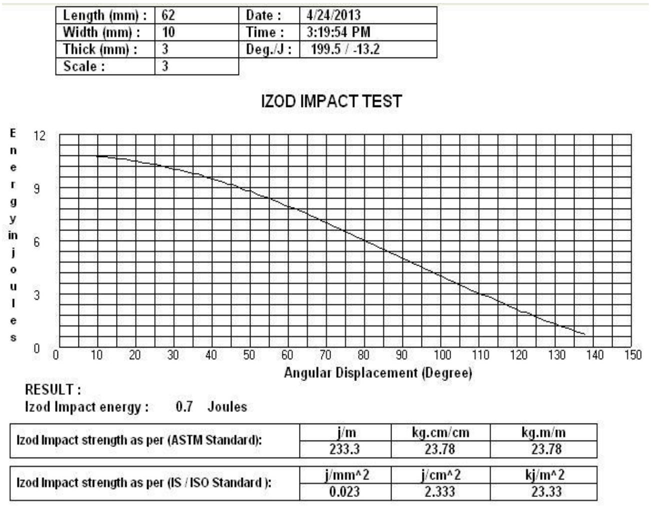
A. **Izod Impact Test-**

PP/Fish Bone Powder blends by varying percentage of fish bone powder from 10%-20%

1. **PP/Fish Bone 10% -**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.70	233.3
2	0.65	216.6
3	0.65	216.6

Sample Graph



1. **PP/Fish Bone 15%-**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.65	216.6
2	0.60	200
3	0.50	166.6

1. **PP/Fish Bone 20%-**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.5	266.6
2	0.65	216.6
3	0.65	216.6

PP/Egg Shell Powder blends by varying percentage of egg shell powder from 10%-20%

2. **PP/Egg Shell Powder 10% -**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.6	200
2	0.6	200
3	0.5	166.6

2. **PP/Egg Shell Powder 15% -**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.5	166.6
2	0.5	166.6
3	0.45	149.9

2. PP/Egg Shell Powder 20% -

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.4	133.3
2	0.45	149.9
3	0.45	149.9

PP, Fish Bone Powder & Egg Shell Powder blends by varying percentage of fish bone powder & egg shell powder from 10%-20%

3. **PP, Fish Bone Powder & Egg Shell Powder 10% -**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.6	200
2	0.5	166.6
3	0.7	233.3

3. PP, Fish Bone Powder & Egg Shell Powder 15% -

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.5	166.6
2	0.5	166.6
3	0.5	166.6

1. **PP, Fish Bone Powder & Egg Shell Powder 20% -**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.45	149.9
2	0.45	149.9
3	0.45	149.9

PP/EPDM blends by varying percentage of EPDM from 10%-20%

4. **PP/EPDM 10% -**

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.5	166.6
2	0.45	149.9
3	0.5	166.6

4. PP/EPDM 15% -

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.45	149.9
2	0.5	166.6
3	0.45	149.9

4. PP/EPDM 20% -

Sr. Number	Impact Energy (J)	Impact Strength (J/m)
1	0.45	149.9
2	0.4	133.3
3	0.4	133.3

B) Tensile Test

1. PP/Fish Bone Powder 10% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	48	5	26.16
2	51.3	8	27.95
3	47.7	14	25.9

2. PP/Fish Bone Powder 15% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	48.3	8	26.32
2	53.7	8	29.26
3	49.5	9	26.97

3. PP/Fish Bone Powder 20% -

Sr. No	Max.Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	46.8	10	25.50
2	48.9	8	26.65
3	43.9	10	23.92

4. PP/Egg Shell Powder 10% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	55.1	5	30.02
2	56.7	4	30.90
3	55.9	4	30.46

5. PP/Egg Shell Powder 15% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	51.5	5	28.06
2	51.5	5	28.06
3	51.3	5	27.95

6. PP/Egg Shell Powder 20% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	46.2	5	25.18
2	48.7	6	30.46
3	47.6	5	25.94

7..PP/FishBonePowder/EggShellPowder 10% -

Sr. No	Max. Load (N)	Elongation(mm)	Tensile Strength(N/mm2)
1	40.1	10	21.85
2	43.4	15	23.65
3	41.8	20	22.50

8. PP/Fish Bone Powder/Egg Shell Powder 15% -

Sr. No	Max.Load(N)	Elongation (mm)	Tensile Strength(N/mm2)
1	49.7	4	27.08
2	56.9	5	31.01
3	46	13	25.07

9. PP/Fish Bone Powder/Egg Shell Powder 20%

Sr. No	Max. Load (N)	Elongation(mm)	Tensile Strength(N/mm2)
1	50.5	10	27.52
2	50.8	9	27.68
3	49.3	8	26.86

10. PP/EPDM 10% -

Sr. No	Max. Load (N)	Elongation(mm)	Tensile Strength(N/mm2)
1	46.3	7	25.23
2	48	10	26.16
3	48.6	9	26.48

11. PP/EPDM 15% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	43.5	8	23.70
2	44.3	7	24.14
3	44.6	7	24.3

12. PP/EPDM 20% -

Sr. No	Max. Load (N)	Elongation (mm)	Tensile Strength (N/mm2)
1	38.2	7	20.819
2	39.8	8	21.364
3	40.1	6	21.85

Specific Gravity Test

Sr. No	Material	Specific Gravity
1	PP/FBP 10%	0.679
2	PP/FBP 15%	0.80
3	PP/FBP 20%	0.88
4	PP/ESP 10%	0.79
5	PP/ESP 15%	0.86
6	PP/ESP 20%	0.84
7	PP/FBP/ESP 10%	0.626
8	PP/FBP/ESP 15%	0.76
9	PP/FBP/ESP 20%	0.835
10	PP/EPDM 10%	0.86
11	PP/EPDM 15%	0.787
12	PP/EPDM 20%	0.848

CONCLUSION

It is seen that, as the percentage of EPDM in blend increases from 0 to 20 %, the impact strength increase. But at the same time tensile strength decrease. Thus incorporation of filler like fish bone powder and egg shell powder prominently enhances the impact strength without considerable decrease in tensile strength. Thus gives a product with balanced properties for end use application.

Egg shell and fish bone powder has been utilized in preparing polypropylene blend. Compared to PP/EPDM blend the Impact strength and Tensile strength increases considerably in case of PP/FBP, PP/ESP and PP/FBP/ESP. The elongation at break of the prepared composites decrease with increase in filler contents.

The specific gravity remains below 1 with varying percentage of fillers.

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