Asian Journal of Chemistry Vol. 22, No. 9 (2010), 7092-7096

Effect of Additive and Raw Material in Filtration Process

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The objective of this study is to find raw material (PP granule) and additive ($CaCO_3$) effect on filtration process in polypropylene bags producing lines. The influence of filtration was checked on physical and thermal properties of tapes (TGA, DSC), tenacity, abrasion resistance, energy, initial modules, *etc*. Two different kind of filter has been used, for producing the tape from 2 different PP granules (MFI) and calcium carbonate has been used as filler with 2 different concentrations. The results show, by increasing the percentage of filler the life time of the filter has been decreased and pressure increased too. Therefore the life time of filter has been decreased around 16 % and the amount of calcium carbonate did not show significant effect in results of tenacity.

Key Words: Filtration process, Polypropylene, Bags, Granule, Calcium carbonate, Basket filter, Autoscreen filter

INTRODUCTION

The use of filler ($CaCO_3$) has been a common practice in the polypropylene (PP) to improve the mechanical properties such as heat distortion temperature, hardness, toughness, stiffness and mold shrinkage. Several parameters in polypropylene tape yarn production line will effect not only on productivity but also on quality of end products, filtration of melt polymer flow before die is one of them. Varieties of filter parameters such as materials, mesh, weave type, number of layer and production processes for assembly of filter can effect on quality and productivity[1-5].

For selecting a filter media several points should be consider: (a) Purpose of filter for filtration, (b) expectation from filter, (c) selection of filter media for particular melts filtration *i.e.*, polypropylene.

Purpose of a filter elements for filtration in flat film process mainly are divided in three topics: (a) filtration (b) screening (c) gel retention or gel shearing. Expectation from filter media is long on stream life, short residence time and long lifetime (clean ability). Properties of filter media material for polymer filtration are strength, temperature, no media migration and chemical resistance polymer and cleaning products. All above mentions properties obtainable only in metal filtration media. Increasing productivity and production efficiency in polypropylene film process

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can not only add value on its production for producer but can also increase demand for these products[6-10].

EXPERIMENTAL

We used two different kind of filter, autoscreen (152 Holes/mm^2) and basket (260 Holes/mm^2) on extruders sequential SML Lenzing-Austria type: ZEX-1139 and Hengli Electric-China type: SJ 120 × 30 and PP Granules from PolyNar and Navid Zar.

TABLE-1
POLYPROPYLENE (PP) GRANULE SPECIFICATION

Item	Raw material	Company	Type	MFI (g/10 min)	Softening point (ºC)	Tensile strength (Mpa)	Elangation (%)
1	PP granule	Navid Zar Chimi	ZH550L	4.5	155	32	11
2	PP granule	Poly Nar	SF-060	7.5	153	36	9

TABLE-2
CALCIUM CARBONATE SPECIFICATION

Item	Raw material	Company	Type	MFI (g/10 min)	Ash content (600 ºC/30 min)
1	Calcium carbonate	Pooya polymer	HS110RF	20	77

Two different mixture of calcium carbonate ($CaCO_3$) with percentage amount were 6 and 10 % were used. In order to compare all above mention parameters. we checked tape yarns physical properties and pressure before filters by 0.1 mega pascal precision. All parameters such as master batch, UV, Denier, temperature and other production parameters kept constant for the period of experimental tests.

Ten meter length aoutoscreen filter operate continuously and change position every 20 min. So, we checked it 10 times for each items but every times a bobbin was taken from same section and used average amount in our calculations[11].

TABLE-3
TESTER INSTRUMENT

Item	Test	Company	Type	Explanation
1	Tenacity	SDL	SN-250	Length 300 mm, velocity 550 mm/min
2	Abrasion resistance	SDL	FF-23	–

In moisture absorbance test, the samples weight was checked which kept for 24 h at 27 ºC, 60 % moisture and another time put them in oven for 0.5 h at 75 ºC and checked variation of weight caused by the time.

RESULTS AND DISCUSSION

Effect of filler on pressure: Due to Figs. 1 and 2 of different calcium carbonate (6 and 10 %), a lapse of time cause pressure increased.

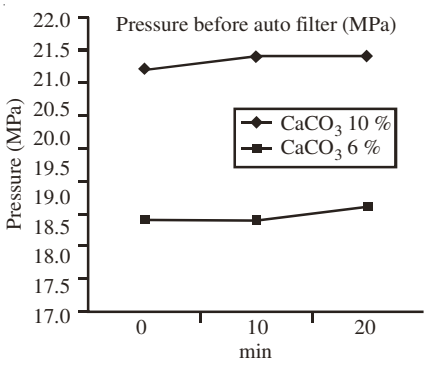

Fig. 1. Variation of autoscreen filter pressure caused by $CaCO_3$ 6 and 10 %

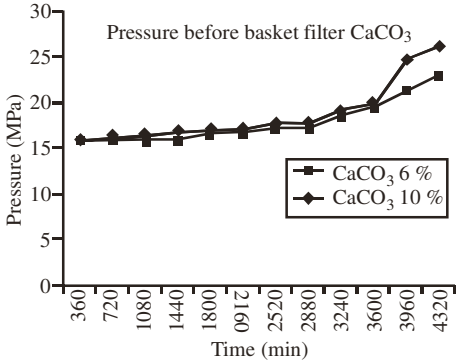

Fig. 2. Variation of bascket filter pressure caused by $CaCO_3$ 6 and 10 %

Fig. 1 shows filter pressure increased up to 11 % with enhancement of calcium carbonate amount with 4 scales: tenacity, elangation and energy test for checking effect of amount of calcium carbonate on tape yarns don't show clear effects. It is noted from Fig. 3 tenacity changed in different pressure irregularly.

According to tenacity graph, there were no rules; just tenacity tolerance was around 8 % and average amount of elongation for different calcium carbonate was 23.42 %, energy at break changed irregularly and it was around 0.844 nm, initial modulus was about 286.92 CN/Tex.

About velocity of tensile tester, we checked different times from 5 s (150 mm/min) up to 20 s (500 mm/min). It caused 5 % increasing in tenacity and as the same results that happened for elongation, strain and energy. But in present studies there is decrease for initial modulus.

Calcium carbonate composition include 23 % polyolefin and 77 % mineral filler, the moisture absorbance and abrasion resistance for different percentage of $CaCO_3$ (6 and 10 %). But there is no difference in both cases.

Effect of different granule MFI on pressure: In Figs. 4 and 5 we saw varieties of differential of granule MFI under invariable amount of calcium carbonate (10 %).

Follow to Fig. 5 although the process was constant but when we used clean filter in first 5 h it was steady then it increased inordinately, coefficient of variation was around 5.09 % for autoscreen filter and for basket filter about 15.3 % (Fig. 6). The average amount of elongation for different calcium carbonate was 24.42 %, energy at break changed irregularly and it was around 0.889 nm, initial modulus was about 288.22 CN/Tex.

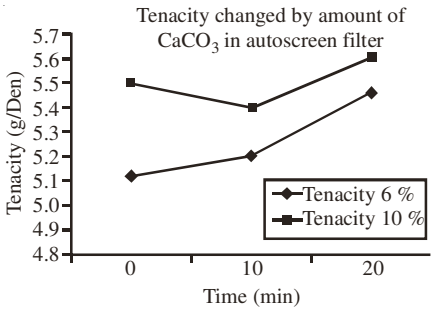

Fig. 3. Tenacity of Tape yarns produced by Autoscreen filter

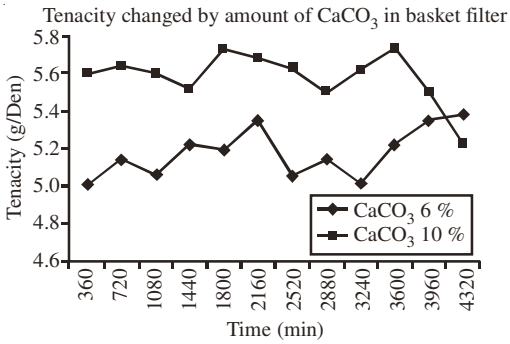

Fig. 4. Tenacity of tape yarns produced by basket filter

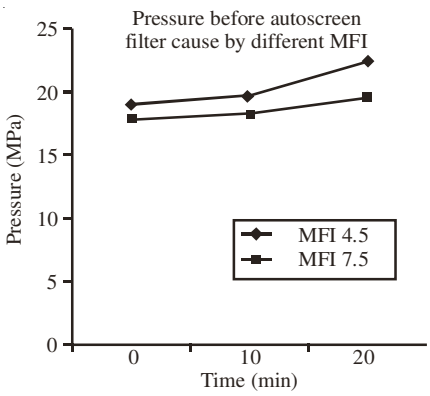

Fig. 5. Pressure before autoscreen filter caused by different granule MFI

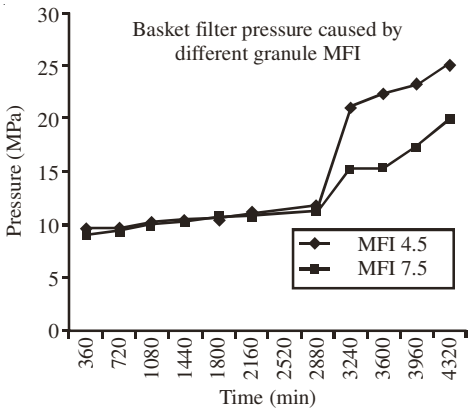

Fig. 6. Show pressure before basket filter caused by different granule MFI

Follow up to tenacity test Fig. 7(a-b) fibrillose enhanced by increasing granule MFI.

Fig. 7. (a) PP MFI 4.5 10 g/min and (b) PP granule MFI 7.5 g/10 min

Conclusion

Filtration process and raw materials have efficiency on quality and productivity, in order to improve stiffness, dimensional stability, *etc*. of polypropylene, fillers such as calcium carbonate is used for enhancement. But unfortunately, it cause decreasing of filter life time.

Autoscreen filter provides better quality of tape yarn. It's help cause less stopage in production. It is easy to use. It automatically changes unclean area to clean on by changing filter positioin. The basket filter tenacity tolerance was around 40 % as compared to autoscreen verities (2 %). The yarn produced by autoscreen filter had steady properties, better filtration and longer life time, which helps producer to use this process further.

In stress-strain diagram increase in amount of carbonate calcium causes the filter life time to decrease and elastic zone to increase. By increasing granule MFI, the period of filter's change enhances. Increased calcium carbonate in the composite of polypropylene doesn't show clear effect in tenacity of tape yarn and tolerance is around 5.8 g/den. The moisture absorbance and the abrasion resistance change a little around 0.4 %.

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(*Received*: 18 January 2010; *Accepted*: 21 June 2010) AJC-8804