

A Review of Experimental investigation Of Twin Screw Extruder (TSE) Machine for Polyvinyl chloride (PVC) Polymer Material

¹Rohit R Limbachiya, ²Vaibhav J Limbachiya

¹M. Tech student, ²Assistant Professor

Mechanical Department,

¹ S.P.B.P.E.C, Mehsana ^{1st} Rohit R Limbachiya, Mehsana, India

¹ rohit_8687@yahoo.com

Abstract— this research aims to investigate the effect of twin screw extruder processing parameters including barrel temperature, screw speed and die zone temperature on the mechanical properties like tensile strength and izod impact of the Polyvinyl chloride (PVC) material. Multi objective evolutionary algorithms have already been used for the optimization of the processing conditions of a co-rotating twin screw extruder. In this research to find out the which processing parameter are most effective on tensile strength and izod impact of PVC material by using ANOVA analysis and some optimization technique. We studied some review paper and decided to research in this field.

Keywords— Twin screw extruder machine, PVC, Tensile strength and izod impact

I. INTRODUCTION (HEADING 1)

Polyvinyl chloride, more commonly known as PVC, is a building block of various products, such as electronic items, constructional materials, stationeries, chemical equipments, wires, cables etc. It is one of the major thermoplastics used today and produced in a huge amount worldwide [1, 2]. Presently there are 50 different basic types of plastics, included in 60,000 different plastics formulations. Those based on polyolefins and polyvinyl chloride, have highest utilization worldwide [3]. As per one estimate, each week in USA, six new plastics materials are sent for evaluation and approval to major testing laboratories [4]. The worldwide production tonnage of PVC is second only to that of low-density polyethylene. However, PVC has inferior processability and thermal stability to those of other commodity plastics, like polyethylene and polystyrene [5]. PVC is thermoplastic and due to its low thermal stability the use of PVC polymer is limited in industry. Several attempts have been made to enhance the thermal stability and mechanical properties of PVC in recent years [6-8]. Unmodified PVC polymer is a brittle, inflexible material with rather limited commercial possibilities. The processing of PVC in the raw form using heat and pressure resulted in severe degradation of the polymer [9].

The utilization of PVC is based on the Compounding. (addition of additives with base polymer) of PVC all over the world. The method of preparing typical recipe for the compounding is known as .Formulation.. With the addition of additives like plasticizers, heat stabilizers, lubricants, fillers and copolymerization with other monomers, the poor properties of PVC can be improved [1, 2]. Commercially, compounding PVC contains sufficient modifying components to the raw polymer to produce a homogeneous mixture suitable for processing and requiring performance at the lowest possible price. The proper compounding and processing PVC resin using suitable additives produces a complex material whose behavior and properties are quite different from the PVC resin by itself [10]. The selection of particular additive is dependent on the end use of the PVC product like PVC-resin is not plasticized for the use in making rigid products such as water pipe, plumbing fittings, and phonograph records.

II. LITERATURE SURVEY

Vikash Agarwal, Jyoti Vimal. et al [11] have been found out optimization of extrusion blow molding process parameters by grey relational analysis and Taguchi method. This research work based on extrusion blow molding process for making plastic container of high density polyethylene grade B6401 (HDPE) and experimental runs based on an L_9 orthogonal array of Taguchi method. The Taguchi method was performed on plastic material and the process parameters were blowing temperature, blowing time and exhaust/cooling time. They also used an optimal parameter combination of the extrusion blow molding process. Extrusion blow molding process was obtained by grey relational analysis and ANOVA analysis from the response table of the average grey relational grade. It is found that the largest value of the grey relational grade for the blowing temperature of 140 °C, the blowing time of 15 second and the cooling/exhaust time of 5 second. Hence, the blowing time is the most significant controlled factor for the extrusion blow molding process when the maximization of the compressive strength and the minimization of the volume error are considered.

Achmat Sarifudin & Alhussein M. Assiry [12] focused on some physicochemical properties of dextrin produced by extrusion process. They applied five different screw speed (35,45,55,65,70) and three temperatures (125°,130°,135°) on properties of dextrin like total soluble solid, water absorption index, water solubility index and total color difference. After the experiment they found that the screw speed and temperature of extrusion were increased the water absorption index of dextrin tended to drop meanwhile the total soluble solid, water absorption index, water solubility index and total color difference where

inclined to rise. The range of total soluble solid, water absorption index, water solubility index and total color difference was 2.1 - 4.6 brix, 159 - 203 %, 20 - 51 %, 3.5 - 14.1, respectively.

Imran Nazir Unar & shaheen Aziz et al. [13] had been found the effect of various additives on the physical properties of polyvinylchloride resin in polyvinyl chloride (PVC) material. They used the different additives for Experimental investigation that was carried out on based PVC material for analyzing the mechanical properties like tensile strength, elongation at break, hardness and physical property. They conducted different test experiment on different PVC material like un-plasticized PVC pipe (rigid), PVC rigid sheet, cable compound, and shoe compound. Resulting output conclude that increasing plasticizer content results in decreasing tensile strength and specific gravity but increasing in elongation at break. On the other hand, increasing the filler content increased the tensile strength but reduced the elongation at break in the absence of plasticizers. So the experimental results carried out by the authors expressed that the addition of various additives in the base polymer (PVC in our case) have great effect on the mechanical properties.

Gaspar, J. A covas. et al.[15] have been Multi-objective EAs have been used for the optimization of the screw geometry of a co-rotating twin screw extruder. The problem consists in finding the most adequate location of a pre-selected set of screw elements, in order to maximize a prescribed performance. Experimental validation has shown the potential of this approach, which is more rapid and less expensive than the classical trial and error procedure. However, improvements in process modeling are still necessary, namely in what concerns mixing, for practical application of the method for compounding operations. The next important step in the algorithm is to provide the possibility of finding the location of screw elements that maximize the prescribed performance from a wider set of available elements, which corresponds to the practical problem in industry.

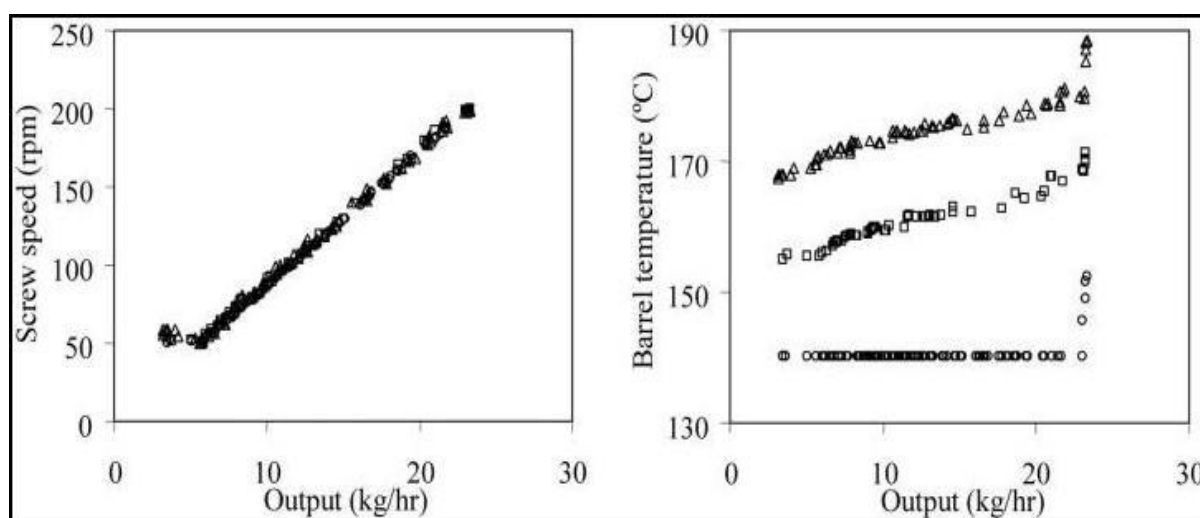


Fig.1 Optimal pareto frontiers in the criteria and variables to optimize domains, for polymerization

Shirin Shokoohi et al. [16] have been found that the effect of the twin screw extruder processing parameters such as the barrel temperature, screw speed and blending sequence on the mechanical properties of ternary polymer blends was investigated by Taguchi design methodology. They have been taken input parameter as a three different barrel temperatures (220°C, 230°C, 240°C), screw speed (90, 120, 150 rpm) and blending sequence (S1, S2 and S3) were selected. Above given input parameters were effected on tensile properties and impact strength of the prepared samples which are affected by the blend microstructure. In this research paper to investigate by Taguchi orthogonal array method, that the optimum processing conditions for the ternary blends to achieve balanced tensile and impact properties, are 220°C, 150 rpm and S2 blending sequence.

M.H.N Famili. et al.[14] have been investigated Fast and Economical Method for Producing of Self-wipe Twin-screw Extruder Modules in After the extrusion process the remaining of polymers in the extruders cause some problems like degradation and impurity in process, therefore after each batch the extruder should be cleaned. Using self-wipe twin-screw extruder is a method. In this research to found out we have presented a novel, quick and economical method for producing self-wipe modules with desirable profiles. studied self-wipe, intermeshing co-rotating screws shape and size by CNC lathe machine so that its use experiments of Fabrication of self-wipe modules by using of common and CNC lathe machine is not possible The prepared screw by these machines may be improved with burnishing to make them similar to the self-wipe profile, but they cannot act as self-wipe modules. Main advantages of this research The maximum wiping efficiency of the modules prepared with conventional method is about 70% of prepared self-wipe modules with this new method needed for preparing of self-wipe modules with this new method is about 10% of the conventional method.



Fig.2 Screw prepared by lathe machine by using of mould



Fig.3 The final modules of the self-wipe screw prepared with lathe m/c by using special cutting tool

III. MATERIAL

Polyvinyl chloride: Polyvinyl chloride (PVC) was first manufactured in Germany in 1931 as a robust and lightweight new plastic. This breakthrough material was brought about to substitute for metals, glass, wood, natural fibers, papers and fabrics. Over 30 million tons of PVC is used around the globe today, both in industrialized and developing countries, due to its cost efficiency, durability, self-extinguishing properties, processability, and resources saving features. Most synthetic resins are made up from single molecule units, called monomers through a chemical reaction known as polymerization, these single molecules are branched into long chain to form of polymer. PVC is also a type of polymer made from Vinyl chloride monomer (VCM) through polymerization.

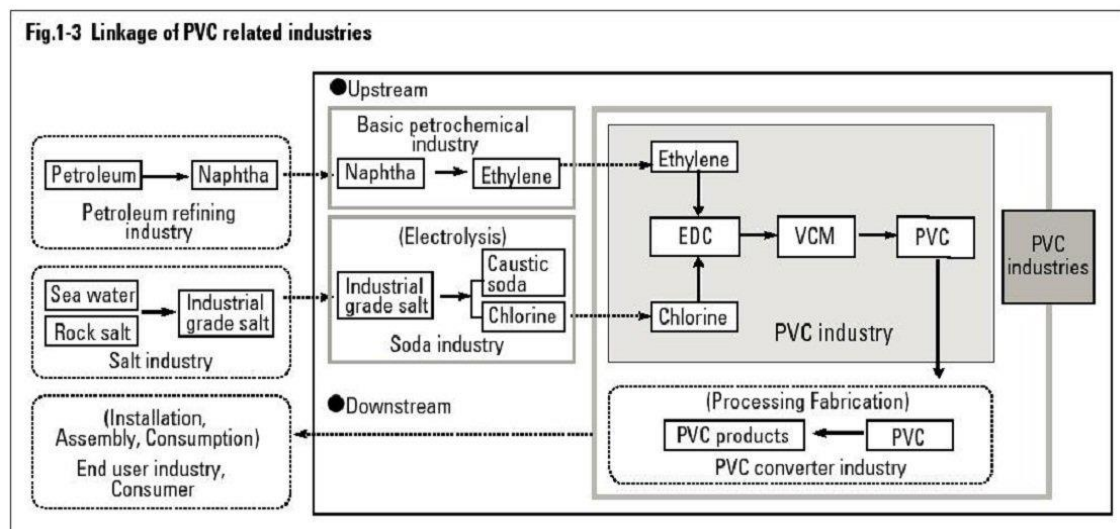


Fig.4 Production process of PVC

IV. CONCLUSION

Literature depicts that a considerable amount of work has been carried out by number of investigators for modeling, simulation and parametric optimization and Pareto Local Search(PLS) algorithm and testing material samples. We find out improvement of screw configuration or increase productivity, The ability of TSE to produce high tolerance, complex profiles and net shaped products leaves the process well suited to many industrial tasks which corresponds to solve the practical problem in industry. For this project input parameters are screw speed, barrel temperature, die zone temperature and output of this some review is some data gives of power consumption and hardness of some mechanical properties and most effective on output parameter is tensile test, flexure test. using solution of twin screw extruder (TSE) machine for polymer material problem by optimization techniques.

REFERENCES

- [1] X. L. Xie, Q. X. Liu, K-Y. L. Robert, X. P. Zhou and Q-X. Zhang, *Polymer* (Elsevier)(2004) 6665.
- [2] K. Endo, *Prog Polym Sci.*, 27 (2002) 2021.
- [3] R. Shashoua, *Inhibiting the deterioration of plasticized polyvinyl chloride*, Ph.D. Thesis (2001), Danish Polymer Center, The Technical University of Denmark.
- [4] A. Quye and C. Williamson, *Plastics, Collecting and Conserving* (NMS Publishing Ltd, Scotland, United Kingdom) (1999)
- [5] P. V. Smallwood, H. F. Mark, N. M. Bikales and C. G. Overberger, *Encyclopedia of polymer science and engineering*, 2nd ed, Vol. 17 Wiley, New York, (1989) 295.
- [6] B. S. Galle, Y. S. Soin, Y.V. Ovchinnikov, E. A. Sereda and G. A. Piskion, *Int. Polym. Sci. Technol.*, 20 (1993) 76
- [7] J. A. Covas, *Polymer*, 34 (1993) 3204
- [8] M. Rogestedt, T. Jonsson and T. Hjertberg, *J. Appl. Polymer. Sci.*, 49 (1993) 1055
- [9] L. I. Nass, *Encyclopedia of PVC*, (Marcel Dekker, New York), 2 (1977)
- [10] J. Gardette, S. Gaumet and J. L. Philippart, *Journal of Applied Polymer Science*, 48 (1993) 1885
- [11] Vikash Agarwal, Jyoti Vimal "Optimization of extrusion blow molding process parameters by grey relational analysis and taguchi method" *IJREAS* Vol. 2(2), Feb-2012.
- [12] Achmat Sarifudin & Alhussein M. Assiry, "Some physicochemical properties of dextrin produced by extrusion process", *Journal of Saudi society of agricultural sciences*, Feb-2013.
- [13] Imran Nazir Unar, Shaheen Aziz, "Effect of various additives on the physical properties of polyvinylchloride resin", *Pak. J. Anal. Environ. Chem.* Vol. 11(2), pp: 44-55, 2010.
- [14] M.H.N. Famili, and S. Moradi, "A fast and economical method for producing of self-wipes twin-screw extruder modules", *The open mechanical engineering journal*.
- [15] A. Gaspar-Cunha, J.A. Covas "Defining the configuration of co-rotating twin-screw extruders with multi-objective evolutionary algorithms.
- [16] Shirin Shokoohi, Ahmed Arefazar, "Compatibilized polypropylene/Ethylene-Propylene- Diene-Monomer/Polymide6 ternary blends: Effect of twin screw extruder processing parameters", *Materials and Design* 32(2011), pp: 1697-1703.