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ORGANIZATION OF RAW MATERIAL & PRODUCTIVITY IMPROVEMENT IN SIDDHARTH PIPE FACTORY

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Abstract— This study present a basic approach to search the root for the existence of defects and wastes in plastic extrusion process in the company. The process and equipment occupied in the pipe production was studied. Qualitative and quantitative analysis were performed to explore factors affecting the production rate and mechanical properties of pipes being produced. The scheme consisted of study melt flow character of HDPE and how the die arrangement should be set to get the preferred HDPE pipes. The drag stream and pressure stream were then extract from the screw parameter which lead into the computation of the action point and the working pressure for the die. It was also possible to calculate the mass flow rate and the velocity drop. And finally die optimization of extruded circular profile is done. Particularly defects such as surface roughness and scratch, bulging, sink marks, uneven wall thickness, dimensional variation, centering problem, tears and marks were identified defects. So many methods like Taguchi, Fuzzy logics are already used to determine the various improvements. This report introduces TQM, TPM, Material handling technique to find defect and to improve overall productivity. The major root causes of each defect were the extrusion process parameters such as, the vacuum pressure, temperature, take-off speed, screw speed of the extrusion process and raw material properties. According to the facts of the company about 76.758% these defects causes are caused by operators. This is due to inappropriate setting of operational parameters. The results showed that the quality of HDPE pipes was good constituting durability and reliability of the products. The major problem observed in the study was the manual processes involved in the production lines which were adversely affecting the direct cost involved in the production. Furthermore, we can conclude that, automation of HDPE pipes production methods must be executed to reduce the direct expenses involved in the production.

Keywords— take-off speed, TQM, TPM, screw, fuzzy logic, bulging, Resin, Extruder, Extrusion, Flow Index, Standard Dimension Ratio, Test-Temperature, Plastic Pipe Industry.

I. INTRODUCTION

This report is basically concerned with the various problems occurred in pipe factory while its manufacturing. Problems like puncture, wastage of material, shrinkage, worker's safety etc are concerned. This report will introduce different methods like 5S, TQM, KAIZEN, TPM, and some other related methods.

In the extrusion of plastics, the rare mix material is commonly in the form of nurdles (small beads, often called resin) that are gravity fed from a top mount hopper into the cask of the extruder. Additives such as colorant and UV inhibitors (in either liquid or bit form) are often used and can be varied into the resin prior to inward at the hopper. The process has much in ordinary with plastic injection mold from the point of the extruder skill, although it differ in that it is usually a incessant process. While pultrusion can present a batch of alike profile in nonstop lengths, usually with extra reinforce, this is attain by pulling the ended product out of a die in its place of extruding the polymer melt through a die.

The material enter through the feed throat (an gap near the rear of the barrel) and comes into contact with the screw. The revolving screw (normally turning at e.g. 120 rpm) forces the artificial beads forward into the animated barrel. The desired extrusion hotness is rarely equal to the set temperature of the barrel due to viscous heating and other effects. In most processes, a heat outline is put for the barrel in which three or extra autonomous PID-controlled heater zones gradually increase the temperature of the barrel from the rear (where the plastic enters) to the front. This allows the plastic bead to melt gradually as they are pressed through the barrel and lowers the risk of overheating which may cause squalor in the polymer.

Extra heat is contribute by the intense pressure and resistance taking place inside the barrel. In fact, if an extrusion row is organization certain materials quick enough, the heaters can be shut off and the melt temperature maintained by force and friction alone inside the barrel.

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In the majority extruders, cooling fan are there to maintain the temperature below a set value if too much heat is generate. If forced air cooling proves lacking then cast-in cooling jackets are employed.

Fig1 Illustrate. Plastic extruder cut in half to illustrate the elements

After transient through the breaker plate melt plastic enter the die. The die is what give the last product its outline and must be intended so that the molten plastic consistently flow from a cylindrical profile, to the product's profile form. Uneven flow at this phase can create a product with surplus residual stress at certain points in the profile which can cause warp upon cooling. A wide variety of shape can be created, restricted to incessant profiles.

II. PROPOSED ALGORITHM

1. The Muna Noor Group (2017) Improvement of Production Process of HDPE Pipes. "Boubyan petrochemical company (k.s.c)1 and kuwait foundation for advancement of sciences" The Muna Noor Group, whose facilities are located all over Oman, specialize in the production and sales of HDPE pipes of various sizes (up to 1.2 meters in diameter) along with PVC pipes and some fittings.
Muna Noor few years ago faced a challenge/problem when it attempted to produce a large diameter HDPE pipe thick walled. The problem was the pipes would sag when attempting to increase the diameter to the required large measurement. Several attempts were made to overcome the problem (trial & error) but ended up in increased costs, wasted time and raw material.
2. Maddock B H (1964), "Measurement and Analysis of Extruder Stability", SPE Journal, Vol. 20, in his work described the case of quality requirement for the extrusion of 1.0 mm thick film. Due to temperature difference the viscosity is affected and the viscosity variations act to produce pressure changes and so caused large thickness variations. High extrusion rates and good extrusion quality are often two extremes and thus incompatible.
3. Tadmor Z and Klein I (1970), "Engineering Principles of Plasticating Extrusion", Van Nostrand Reinhold Company, New York classified bad mixing of the components forming the product can result in bad appearance and a non-uniform product. Non uniformity in products can lead to weakness of mechanical strength. Poor extrusion quality for a given extruder is frequently related to random difference of temperature, pressure, and flow rate.
4. Dowd L E (1962), "How to Minimize Puckering in Polyethylene Cast Films", Modern Plastics, Vol. 40, reported that the product properties are depends on the extrudate temperature.
5. Fenner, et al.(1977) also stated that screw cooling reduces throughput, thus eliminating these fluctuations without cooling the screw will allow these extruders to achieve a higher level of productivity. And extrusion experts identify five factors that limit product throughput and quality: power or screw speed, temperature, feed, vacuum pressure, and downstream processing.
6. Lei Zhang1 , Zhihong Fu1 , Chen Yao1 , Gongzheng Zang1 , Yue Wan1 1 (2017) College of Mechanical and Electrical Engineering, Central South University, Changsha, 410083,China In this paper, the finite element software was used to replicate the plan of extrusion die and vaccum calibrators of plastic gears. The best dimension of the die was determined, which provided the basis for the design and processing. The course parameter that prejudiced the accuracy of tooth contour was performed by univariate study and rules were obtained.
7. M. Narasimha, R Rejikumar(2013) "Plastic Pipe Defects Minimization()" the major root causes of each defect were the extrusion process parameters such as, the vacuum pressure, temperature, take-off speed, screw speed of the extrusion process and raw material properties. According to the data of the company about 76.758% these root causes are caused by operators. This is due to inappropriate setting of operational parameters.
8. Chandan venkatesh (2012) "Performance Comparison of high density polyethylene pipe (hdpe) in municipal water applications" Most common causes of failure happening in small diameter pipes were because of joint failure. Due to lack of sufficient big diameter HDPE pipe respondents, the consequences were not decisive. The failure modes of HDPE water pipes include cracking, joint failures, third party injure, poor installation and inspection, and failure due to oxidation.
9. Mark A. Spalding (2003) "Troubleshooting mixing problems in single-screw extruders" The importance of the melting process on mixing is often overlooked. The work presented in this clearly shows that proper melting is a key to having a high quality discharge for downstream forming applications. Although numerous methods exist for improving mixing, some of the more common methods are described here, including the use of high performance screw designs.

10. Mr. Sandip S. Gadekar, Prof. Javed G. Khan, Dr. R. S. Dalu (2015)"Analysis of Process Parameters for Optimization of Plastic Extrusion in Pipe Manufacturing" The study in the process shows that rude location of ready parameter kept on a great share of the cause for pieces and non-conformance of the product and the learn being conduct shows that scenery of best outfitted parameters using Taguchi's method of design of experiment is a good method in minimize piece rates.

11. Geo Raju, Mohan Lal Sharma, Makkhan Lal Meena (2014)" Recent Methods for Optimization of Plastic Extrusion Process: A Literature Review" In this report ANN and GA are emerging as the novel approach in the resolve of the procedure parameters for plastic extrusion. A taught neural system can quickly give a set of extrusion parameters according to the results of the predict excellence of extruded parts. However, the time necessary in the teaching and retraining for a neural network could be extremely long. By using GA approach, the system can nearby optimize the extrusion parameters even with no information about the process.

12. Krupal Pawar ,Sachin Jadhav, Ashwin Dumbre, Sunny A.V., Girish H. S., Anil G. Yadav (2017)"Experimental Investigation to Optimize the Extrusion Process for PVC Pipe: A Case of Industry Krupal Pawar" In the current research work, the optimize extrusion process parameters for maximize the PVC pipe wall width using Taguchi's technique are investigate. The die high temperature is most important procedure parameter in PVC pipe extrusion process and the second most major factor is extrusion stress which affects the PVC pipe wall thickness.

13. Sachin Mahendru, Bikramjit Singh(2015) "DMAIC-Measuring the PVC Pipe Manufacturing Process" It known disturbed wall thickness, circumferential waviness and diameter disparity as main defect that crash the weight. After analyze Ishikawa diagram, feeder RPM, barrel zone temperatures, connecting head temperatures, quenching temperature, haul-off RPM were recognized as serious to procedure parameter.

14. S.Ravi and P.A.Balakrishnan in (2009) "Design of Synthetic Optimizing Neuro Fuzzy Temperature Controller for Twin Screw Profile Plastic Extruder Using Labview" developed Genetic Algorithm based Fuzzy Logic Controller for temperature control in a plastic extrusion and experienced from side to side a imitation study. A novel GA base FLC technique was implement to design a possible advanced controller. Obvious characteristic of the future technique was smooth of undesired control signal of mamdani type FLC controller. Plastic extrusion scheme is usually nonlinear and the temperature of the plastic extrusion scheme may vary over a wide variety subjected to a variety of turbulence. The system was intended with two different control technique to control temperature at dissimilar set point change and as well as to control sudden input disturbances.

15. Sachin Man Bajimaya et al. (2007) "Neural network-based estimation of indirect aluminum extrusion process parameters" estimated realistic chief extrusion procedure parameters by means of simulated neural network. The simulated neural network-based opinion of the extrusion process parameter previous to plant implementation helps to create the real extrusion action more well-organized because more practical parameters may be obtain. And so, it bridge the gap between imitation and real developed implementation system. In this work, a appropriate neural network is intended which is taught using an suitable knowledge algorithm. The network so taught is used to expect the developed process parameters.[6]

16. (Kang, 2014) Investigation to carry out fractured properties at Blekinge Institute of Science. This study was carried out to study the fracture properties of the HDPE pipes. Microscopic examination to study the textures involved in fractures of pipes were carried out. This study also involves numerical simulation(ABACUS) to find good shear test match for avoiding fracture mechanism. This study primarily focuses on the mechanism of fracture but lacks the application from commercial aspects and improvisation of economic factors involved.

17. (Shree, 2014) Investigation of durability and reliability of HDPE pipe for large diameter water transmission applications at the university of Texas at Arlington. This research primarily focuses on the use of HDPE pipes in water transmission lines. It emphasizes on the satisfaction rate of consumers who use large diameter HDPE in water transmission. Results have shown that the users of this product are highly satisfied and did not face much hurdles in a long-term run. The only problem involved was about the joint fittings involved in the process. From this research, we can assume that HDPE pipes are a good product and can be used for water transmission lines in long run.

18. (Dr. Jeremy Leggoe, 2017) Investigation of root cause of polyethylene pipe leaks & bursts. This study provides a clear picture on the fact of increasing demand of HDPE pipe demands and their application. They have assumed that the chlorinated water transmission at early stages of polyethylene pipes showed frequently occurring pipe burst and leakages. From this study, we can estimate the need for improvisation of mechanical strength of the pipes and hence find ways to make it cost effective. Also, find the preventive measures to avoid these problems, consequently, increase the durability, reliability of the final products.

III. EXPERIMENT AND RESULT

MY APPROACH TO QUALITY CONTROL AND QUALITY ASSURANCE IN SIDDHARTH PIPES

Assure the high-quality raw materials to be use in the manufacture of pipes is the primary important and significant condition for compliance with the specific needs of the finished product. HDPE resins used to make polyethylene pipe must be analysed, tested and approved for use to ensure NSTM portrayal necessities. Resin supplier's accreditation portraying the material and communicating consistence with all essentials must run with all unrefined raw materials used in

the production of the pipe. The pipe maker's commitment includes testing, randomly picked samples from each part lot for certifying density, melt index, tensile strength and environmental stress crack resistance. For reference and gathering process control purposes, recognized material packages should be doled out recognizing numbers. Permanent records should be kept. Control of the idea of the pipe delivering process is the accompanying fundamental and essential condition for consistence consolidates the going with.

Controlling the manufacturing process is the next significant step. A highly recommended quality control program for manufacturing process are as follows:

• serious examination of every movement using visual and in addition automated inspection procedures
• testing trial of the finished pipe, done at predetermined frequency (NSTM/ PPI)

Despite records of the above things, and to ensure traceability of the made pipe, quality control reports must record the plant, date and move of manufacture, production line and resin. Each modifying thing ought to be identified with enduring markings exhibiting the manufacturer, creating plant, date of production, applicable specific task and the pipe's nominal diameter.

Standard QA/QC (Quality Analysis/ Quality Control) program will fuse irregular audits of the feasibility of the program itself. Such surveys will generally address:

• evaluation of manufactured pipe and fittings in stock
• examination and recalibration (if fundamental) of QC testing instrument
• QC examination and reporting systems
• raw material reviewing, testing and package control systems
• product accreditation techniques
• collecting customer feedbacks; helpful exercises
• processing of recommendations from plant personnel.

IV. CONCLUSION

The extrusion process was investigated using the screw characteristics, die characteristics and material characteristics. There were different die structures used for producing pipes of various SDR. Die structure was varied to produce the required size and weight of weight. The melt flow characteristics study showed that they depend upon screw rotation speed and die-structure used. Also, we found that melt flow of the raw materials has an inverse relationship with pressure involved and the rotation speed of screw. The shear stress was kept balanced by maintaining constant supply of raw materials along with the constant heat and pressure during the extrusion. It was also known that the pipes production was best at the maximum amount supplied and reduced non-uniformity present in SDR of the products and the weight.

It was really a great opportunity to look inside and to work with pipe factory members in Siddharth pipe factory, Sidgua. From this study, I learnt the core mechanism and simple working formula are important than the upgrades. Factory was not old, but the infrastructures used to extrude plastic were old-fashioned. I learnt how simple things works together to give complex products. Winding and cutting were done manually, which is very difficult to perform precise cutting, but was done nicely by experienced cutter in factory. Since extrusion process is long and continuous process the factory had accommodation services to all their employees. Infrastructure for good and experienced engineers are lacking in the factory. Regular updates in machines and collaborating with good Plastics Engineers, the number of products and quality of the products in factory can be increased.

The processes can be automated to increase the rate of HDPE pipes production. Consequently, the number of labours used for the processes are eliminated and hence decrease the direct cost for the final product. Also, cutting the pipes and making the raw materials manually is a risky process, i.e. a lot of human risk factors are involved since it involves use of sharp tools continuously for long time.

Amount of recycled waste at local level can be increased, since the factory does not always get the raw material at time and of good quality sometimes. On the other hand, it can provide employment opportunities at local level and can also, decrease the direct cost of product. It will help the surrounding communities to promote green-ecosystem by reducing Plastic Wastes.

The following is the list of properties of Pipe products that needs to be ensured for quality products and good feedback:

- Minimum inside diameter
- Liner thickness
- Length
- Perforations
- Pipe stiffness
- Pipe flattening
- Environmental stress cracking
- Brittleness
- Joint integrity (for fittings)

From the Study and analysis of the various papers on the defect and observing their views of researchers by paper in extrusion process there should be need of minimizing its causes for the best extrusion product. These quality troubles (Causes) are turn out to be unsuitable situation of operational parameters as per observation. By the use of over remedy the proportion of loss would be get better, as predicted, for the products.

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