DETAIL STUDY & OPTIMIZATION OF LEAKAGE IN SCREEN CHANGER USED IN PLASTIC EXTRUSION MACHINE

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ABSTRACT:-

As the increase in the use of plastic products as compared to different material due its good strength and its light weight factor, the main challenge comes to its production with least cost to make it most economic. Therefore, one must find the most effective way to reduce the cost.

Wastage of the material being one of the factors for the loss in the production must be reduced. Hence considering it as an important factor for the production loss research and development is important. Taking reference from the research and development of a plastic extrusion machine. The paper is based on the modification of a screen changer used in the machine to remove harmful contaminants from the material entering the dye. As observed practically, there's a leak of material from the screen exchanger. So, the main aim of this research is solely based of optimizing the leakage occurring from the screen changer.

KEYWORDS:-

1. Screen Changer
2. Extrusion Machine
3. Leakage
4. Plastic Extrusion

INTRODUCTION:-

In the extrusion of plastics, the raw compound material is commonly in the form of nurdles (small beads, often called resin) that are gravity fed from a top mounted hopper into the barrel of the extruder. Additives such as colorants and UV inhibitors (in either liquid or pellet form) are often used and can be mixed into the resin prior to arriving at the hopper.

The process has much in common with plastic injection molding from the point of the extruder technology, although it differs in that it is usually a continuous process. While pultrusion can offer many similar profiles in continuous lengths, usually with added reinforcing, this is achieved by pulling the finished product out of a die instead of extruding the polymer melt through a die.

The material enters through the feed throat (an opening near the rear of the barrel) and comes into contact with the screw. The rotating screw (normally turning at e.g. 120 rpm) forces the plastic

beads forward into the heated barrel. The desired extrusion temperature is rarely equal to the set temperature of the barrel due to viscous heating and other effects.

At the front of the barrel, the molten plastic leaves the screw and travels through a screen pack to remove any contaminants in the melt. The screens are reinforced by a breaker plate (a thick metal puck with many holes drilled through it) since the pressure at this point can exceed 5,000 psi (34 MPa).

After passing through the breaker plate molten plastic enters the die. The die is what gives the final product its profile and must be designed so that the molten plastic evenly flows from a cylindrical profile, to the product's profile shape. Uneven flow at this stage can produce a product with unwanted residual stresses at certain points in the profile which can cause warping upon cooling. A wide variety of shapes can be created, restricted to continuous profiles.

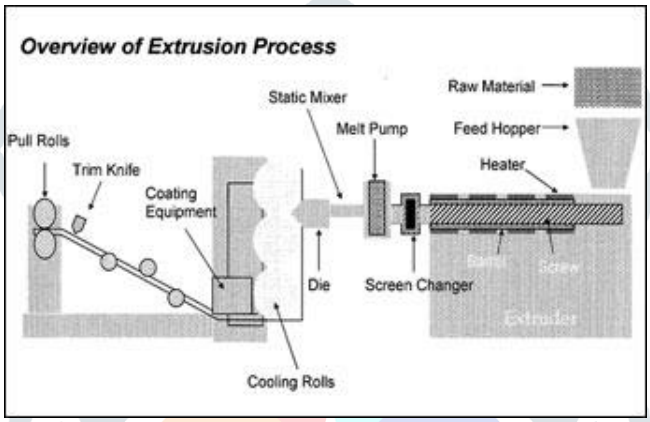

FIG: - Overview of extrusion process & stating the assembly of screen changer in machine.

Melt filtration is typically used to remove contaminants from polymer melts during the extrusion process. There is a mechanical separation of the contaminants within a machine called a 'screen exchanger'. A typical system will consist of a steel housing with the filtration medium contained in moveable pistons or slide plates that enable the processor to remove the screens from the extruder flow without stopping production.

The contaminants are usually collected on woven wire screens which are supported on a stainless steel plate called a 'breaker plate'—a strong circular piece of steel drilled with large holes to allow the flow of the polymer melt. For the recycling of polyester it is typical to integrate a screen changer into the extrusion line.

WORKING & OPTIMIZATION: -

According to the invention, there is provided a screening device having an arrangement for replacing a dirty or blocked screen with a clean screen, said device comprising body member having a passage there through for the flow of material to be screened and having an angular movement of the screen on a pivot point, two separate screen blocks each including a plurality of bores therein

communicating with opposite faces of the block the screen rotates on a pivot point in an angular manner with a certain restriction in degree.

Conduits formed in the body member to permit material to be bled from the passage through a first of said conduits into the interior of the other block whilst adjacent the passage to fill the block interior and to remove therefrom air or air and foreign matter through a second of said conduits communicating with the exterior of the body member valve means disposed in one of said conduits for controlling the flow of material through the conduits, and drive means operable to cause the other screen to rotate said one screen from its location in said passage so as to replace it with other screen, so as to clean or replace the screen which is choked up with foreign particle.

Now with design used normally in the industry, the issue of leakage is experienced & observed practically. The occurrence of leakage in the design is due to the surfaces not aligning parallel to each other. Since it being a mechanical component one need to provided tolerance and allowances in the design, which may give an angular surfaces w.r.t to each other. Hence providing a passage for the flow-able matter to pour itself out of the component.

So, now to optimize leakage one must find a way to seal the said passage by maintaining the parallelism of the surface so that there's no passage for the matter to flow out. This can be achieved in different way. I have kept an arrangement for the seal rings to maintain the surface parallelism. The inner seal is so designed that it gets expand on gaining temperatures uniformly inside the hole. And the expansions in turn helps in pushing/sliding the outer seal in an angular manner so that to maintain the parallelism.

The inner seal helps by its linear expansion in pushing the said outer seal, where as its radial expansion helps in providing a sealed environment. Whereas, the sleeve gains the movement from the inner seal and helps the outer seal to maintain the surface. And in this way it creates an isolated passage for the flow-able matter to pass through the component and entering into die in a purified form.

RESULT & CONCLUSION:-

The leakage previously observed practically ranged from 5-8% approximately of the production rate per hour of the batch production. While the newer concept may result into a totally leak proof assembly, providing the user to work with 0% material loss. Hence, it is concluded that the conceptual changed design would work in an appropriate manner solving the problem by optimizing leakage. The problem of geometric parallelism will be solved by the suggested changes.

REFERENCE: -

1. J.K. Gupta and R.S. Khurmi (2005)

Machine Design by S. Chand publications, reprint (2014), Pages 224-260.

2. A. Whelan , D. Dunning, (2005)

Developments in Plastics Technology-1: Extrusion, Pages 45-58 etc.

3. Sidney Levy published, (1981)

Plastics Extrusion Technology Handbook, Pages 82-86 etc.

4. **https://patents.google.com/patent/US2854691A/en**
5. **https://scholar.google.co.in/**
6. **https://www.springeropen.com/journals#Engineering**
7. **https://en.wikipedia.org/wiki/PET_bottle_recycling**
8. **https://en.wikipedia.org/wiki/Plastics_extrusion**
9. **https://patents.google.com/patent/US3962092A/en**

10.Chris Rauwendaal, (10/01/2001)

Title: - Extrusion process and trouble shooting. Ptonline magazine.

11.Chris Rauwendaal, (01/04/2011)

Title: - Extrusion productivity & energy costs. Ptonline magazine.

12.Keith C. Behnke, (04/06/1995)

Title: - Extrusion equipment design. Feedmachinery articles.

13.Don McNamara, Bart Jones, (25/05/2015)

Title: - screen Exchanger in flow, Plastic technology magazine.