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BRIQUETTING ROLLER PRESS MACHINE FOR PHARMACEUTICAL INDUSTRY

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Abstract : The process of making tablets includes several steps which includes granulation, compression, coating etc. Here the tablet compression is an important step in tablet manufacturing as it affects the shape, size and density of the product. A rotary press machine is most commonly used for tablet compression in pharmaceutical industries. Although rotary press machine gives good results it results in high power consumption and high labour costs. This current paper focuses on an alternate method for tablet compression process using Briquetting roller press machine. This will help to increase the rate of production, reduce power consumption and cut down labour costs.

IndexTerms **- Roller press machine, pharmaceutical industry, design, briquetting roller, proposed system, process mapping**

I. INTRODUCTION

The roller briquetting press is a kind of briquetting machine that is widely used in the industry area today. The briquetting machine is mainly used to process tailing disposals and suppress powder materials that are hard to take shape. The working principle is simple: raw materials are fed between two counter-rotating rollers, which are furnished with synchronized moulds that define the product shape. The material to be briquetted is introduced into the nip between the two rollers by means of a feeder system. On passing through the roller gap, the material is compacted and formed into briquettes of uniform size and shape, enabling its inherent resources to be utilized in subsequent production cycles. In briquetting machines, the rollers are parallel to one another and rotate in opposite directions with the same rotational speed rate. Briquette machine is mainly used to make balls from the ferrous and non-ferrous metal powders by throwing them directly into the smelting furnace which increases the additional value. Briquettes machines are widely used to press all kinds of materials such as fly ash, pool mud, oxide skin, steel slag, iron powder, aluminium powder, manganese mineral powder, aluminium skimming, active carbon, alumina, bauxite, causticity, charcoal, clay, coke breeze, coal, cryolite, chemical fertilizer, plastics, lime stone, paintings, urea, sylvite, etc. Briquetting machine for sale can help to reduce dust, control the capacity, recycle materials and improve the transportation performance, etc.

II. LITERATURE REVIEW

Zhu et.al. published a paper on investigation of the Specularite concentrate and employ a pre-briquetting process to improve granulation of sintering mixture[1]. Ganesan and Vedagiri published a paper on how the agriculture waste (Biomass) has been used for Briquette formation from de-oiled Cashew nut shell and compare in with Coal & charcoal[2]. Chen et.al.published a paper which talks about improving the production of straw briquettes with reduced power Consumption thereby reducing ring die wear[3]. Hasan et.al. published a paper performing finite element analysis of briquetting of iron ore fines[4]. Bembenek et.al. published a paper analyzing the impact of consolidated material on the morphology of briquettes produced in a roller press[5]. Aragón-Gonzáles et.al. published a paper on the design construction and starting up of a automatic tableting machine[6]. Gousia Begum et.al. published a paper covering the critical aspects of pharmaceutical press machines and the defects arising in tablets[7]. Bembenek et.al. used discrete element method to study the process of briquetting of fine fraction materials in roller presses with a complex configuration of forming elements. DEM(Discrete Element Method) was used to model the behaviour and determine the physical and mechanical properties (compaction coefficient, Young's modulus, cohesion energy) of the studied materials—calcium hydroxide and cooper concentrate mixture[8]. Krawczyk et.al. published a paper which defined the wear process of rollers made of 20Cr4[9]. Rathod et.al. published a paper studying various types of tablet compressing machines and tooling methods a In this work, selection of tooling was done by referring to the TSM (Tablet Specification Manual), which specify the dimensions of punch and dies and other factors affecting the machine[10]. Algorri et.al. published a paper proving a overview of the regulatory barriers as well as emerging opportunities to facilitate the use of agile manufacturing for the production of pharmaceutical products[11]. Arden et.al. published a paper discussing the applications and deployment of industry 4.0 technologies in the pharmaceutical industry[12]. Varghese et.al. published a paper on the recent advancements in additive manufacturing in the pharmaceutical industry[13]. Arshad et.al. published a paper providing an insight about the advances in tablet excipients, manufacturing, analytical techniques and deployment of Quality by Design[14]. Considering the past developments carried out in the pharmaceutical industry it is seen that the pharmaceutical industry is adapting new technologies for manufacturing of medicines or drugs at aa faster rate. Various developments or experimental works have also been carried out on the briquetting rollers. But it is also seen that the pharmaceutical industry is using the same

conventional methods of manufacturing in some areas. One such area is of tablet compression, where the rotary press machine is still being used. Although rotary press machine gives good results it results in high power consumption and high labour costs. Hence there arises a need to develop an alternative to the traditional rotary press machine. Considering this, the current paper discusses the use of an alternative method for tablet compression in the following section.

III. PROCESS MAPPING

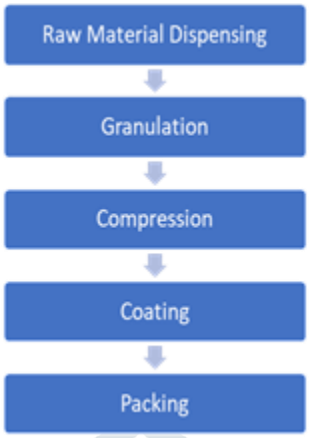

Fig. 1. Tablet Manufacturing Process

In the first step i.e. raw material dispensing Active Pharmaceutical Ingredient (API) undergoes processes like sitting, milling and dry mixing. In the second step of Granulation the tablet powder is sized and lubricated with an additive called magnesium stearate. In the third phase the granulated compound is fed to the Hot Metallic Extruder (HME) machine from which the output is then fed to the rotary press machine where the compression of the tablet takes place, which gives the required shape and size to the tablet. Then, in the next step the tablet is coated with a chemical film. Finally, the tablets are then packed and released for supply.

IV. PROPOSED SYSTEM

In the third phase of tablet manufacturing i.e., during the compression process the output of the Hot Metallic Extruder (HME) machine will be fed into the Briquetting Roller press machine, which will be used in place of the rotary press machine.

Construction and Working

The Briquetting roller press machine consists of a Machine frame onto which the assembly of rollers, gears etc. are mounted. There are two bottom rollers and two upper rollers attached to the roller support and two briquetting rollers attached to the machine frame. Gears are mounted onto the shaft containing the rollers. A timer belt is attached to the gears so

that the process takes place synchronously. A discharge chute is attached to the frame, from where the end product is collected. The output of the Hot Metallic Extruder machine which is in semi solid form having thickness of about 15mm passes through the first stage of rollers where it is compressed to a thickness of 10 mm and as it passed through the second stage of rollers it gets compressed to a thickness of 5mm. Finally, the material then passed though the briquetting roller where it is compressed to the required shape and size and the tablet capsules fall on the discharge chute from where they are collected and sent for coating process.

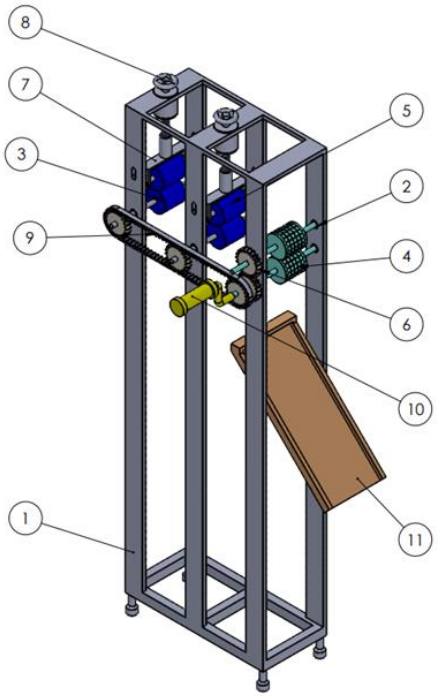

Fig. 2. Briquetting Roller Press Machine Design

Table 1: List of Components

Item Number	Part Name	Qty.
1	Machine Frame	1
2	Bearing	12
3	Bottom Roller	2
4	Briquetting Roller	2
5	Upper Roller	2
6	Spur Gear	5
7	Roller Support	2
8	Height Adjustment Knob	2
9	Timing Belt	1
10	Handle	1
11	Discharge Chute	1

V. RESULTS AND DISCUSSION

After acquiring adequate knowledge about the briquetting roller, the following results were thoroughly analysed to surpass our design compared to the existing machine. The power consumed to handle/run the current machine requires a rough amount of 5 HP whereas the new design has the potential to complete its task within 0.25 HP, saving both the electricity and the time for other productive operator resources. This results in good use of manpower with only one skilled operator to be used handy instead of two for the initial work like handling and operating the machine. The new design is built with accurate precision which enables the machine to work on multipurpose activities with minute errors and will be more efficient than the existing machine. Not only is this newly designed machine multipurpose, but it can also be used for several materials like Semi liquid Granules, Gum, etc., unlike the current machine which is capable only of Solid Granules. The main USP of our project is that it can produce relatively more tablets depending on the size and speed of the roller and it is beneficial to the company as it will achieve a substantial result by producing more than 50,000 tablets for which the current machine is designed.

Table 2: Comparison between existing and new system

Parameters	Current System	New System
Power Consumption	5 HP	0.25HP
Man Power	2	1
Labour Jobs	Do Setting/ Handling/	All in one
Usage	Single Work	Multipurpose
Power Source	Hydraulic/ Pneumatic	Electrical/ Mechanical
Type of Raw material	Only Solid Granules	Semi Liquid Granules/ Gum etc.
Rate of Production	50,000 Tablets	Depends on Roller size and speed

VI. Conclusion

The design and analysis of the briquetting roller lead to the following conclusions:
The design enabled to eject the custom pocket sizes and shapes easily without any pressure and difficulties. The roller is comparatively easy to maintain and keep the machine proper under working conditions. It has a variable speed roller and force feeder drives to achieve high product quality. It is also beneficial in reducing the power consumption and the labour costs, to enhance the production rate more efficiently.

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