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MULTI AXIS GLOBAL MIXER FOR PAINT & SEMI-SOLID MIXING

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***ABSTRACT*:-Mixing of powder is a common is a common industrial operation nowadays. Powder are often cohesive, Many agglomerate spontaneously when exposed to humid atmosphere or elevated storage temperature. Agitation of the powder with different bulk density with may result in migration smaller particles downwards & of larger one upwards. Another major problem is a segregation whose main cause is the difference in particles size, density, shape and resilience generally seen in any ball milling operation. Conventional mixer cannot serve this blending purpose thoroughly. So it is necessary to produce a product which having a combination rotating, tumbling & shaking moments of material in a container which has close and constrained invertible kinematic link-work at least one link serves as receptacle for a container.**

KEYWORDS—Powder mixing, Blending & Agitation.

INTRODUCTION

In case of process industries, process of mixing and stirring forms and integral and the important part of the total manufacturing process. Mixing is the process which determines uniformity and over all quality of product .Process industries like chemical plants, food processing plants, paint industry etc, largely employ mechanical mixers to carry out mixing of powders , semisolid jelly fluids etc .Mixing is a process where powder or jellies are mixed together through in the form of uniform mixture where stirring is the process to mix the fluid and powder to dissolve the powder thoroughly in given mixture and form a uniform product or output. In either of above cases thorough mixing of material is desirable to give and good and uniform quality output . Mixing of powders of different material in order to form a uniform product or a powder mix is quiet easy but when it is desirable to mix powder in a fluid matter specially when the density of powder is high the problem occurs due to heavy weight of particles of powder has a tendency to settle down. In conventional method of mixing the metal oxide powder and vehicle mixing is carried out on a vertical shaft mixer with a static mixer blade at the bottom ,this machine the motor is driven on reduction gear box through coupling the output shaft of gear box is coupled to stirrer shaft to which the blades are connected , when the motor rotates output shaft of gear box rotates at slow speed. There by driving the stirrer.The stirrer rotates in one direction to agitate the mixture to prepare paint. Mixing devices can be classified into two groups with respect to segregation: segregating mixers—which have mainly diffusive mechanisms, encouraging the movement of individual particles, making segregation more significant, non-impeller type mixers tend to be of this type. Less segregating mixers—have mainly convective mixing mechanisms. These are typically impeller types in which blades, screws, ploughs, etc. sweep groups of particles through the mixing zone. Mixing devices are chosen according to the material mixed; therefore, it is important to know the particle size as well as their flow properties. The variability of powders arises from the many ways in which their flow properties may be changed such as: physical properties of the powder particles such as their size, size range, shape, hardness, elasticity, porosity, mass, interactions between particles, texture, angularity and so on. Environmental factors that affect the powder bulk properties, such as the air or moisture content, external pressure, vibration, etc. These factors modify the physical distribution and arrangement of the particles in the powder mass. Individual particle changes .In conventional method of mixing the metal oxide powder and vehicle mixing is carried out on *'UNI-DIRECTIONAL STIRRING MACHINE'*. In this machine the motor is driven on reduction gear box through coupling the output shaft of gear box is coupled to stirrer shaft to which the blades are connected , when the motor rotates output shaft of gear box rotates at slow speed. There by driving the stirrer. The stirrer rotates in one direction to agitate the mixture to prepare

paint or mixture. The other type being the V-blender consists of two cylindrical sections joined at an angle of around 90◦, it is designed for batch operation. The angle between the cylinder and the centre line in the off-axis rotating drum mixer is 40◦. The mixer is rotated about a horizontal axis, with mixing resulting from the tumbling motion of the particles.In a static mixer the main mechanism in laminar flow (Reynolds's number<2000) is the flow division. Element styles are three helical or pseudo-helical, and are arranged in a series of alternating left and right hand 180◦ twists. The leading edge of an element, which is on a diameter, is at 90◦ to the trailing edge of the upstream element. In flow division, the leading edge of the first element splits the material entering the mixer into 2 streams, which are then rotated through 180◦. The second element splits the flow again, this time into 4 streams, followed by a further rotation, in the opposite direction, through 180◦. The third element repeats the process by splitting into 8 streams, and so on. As the number of streams or layers increases, the layer thickness decreases. Mixture quality is a function only of the mixer diameter and the number of elements and, in the laminar flow, is independent of the flow rate or viscosity. In solid/solid mixing the unit is usually vertical with the flow being by gravity only. The material is removed below the mixer by an assembly line.

LITERATURE REVIEW

- International Journal of Scientific Development and Research (JAERS) published a paper in April-June 2013. Titled "MIXER A STUDY ON MIXING OF COMPOSITE SOLIDS IN THE THREE DIMENSIONAL TURBULA". This paper was published by Prof P.S.Jadhav&B.R.Jadhav . The study was made on two machine that was Random mixer &Turbulamixer . As turbula mixer & random mixer was having a mixture of Paraffin oil & W-cu. The result for random mixer was segiration of both the mixer and mixture of powder and oil was not perfect , similarly on other hand turbula mixer creates share force , therefore powder are subjected to pure mixing ; in a sense. As a result the green compact is not damaged or deformed. The efficiency as well as performance is more in Turbula mixer. [JAERS / VOLUME 2/ ISSUE 3/ APRIL-JUNE,2013-14].

- International Journal of Scientific Development and Research. Titled "SYENTESIS OF PART ORIENTING DEVICES FOR SPATIAL ASSEMBLY TASK". This paper was published by P. Larochelle . The study was made on spherical mechanism , exact motion synthesis ,approximate motion synthesis that is applied on spherical open &close kinematic chain. Part Orienting Devices is designed for the foundation of degree of freedom for robotic motion etc. [JIJETSFL 329016975, U.S.A].

- International Journal of Scientific Development and Research (IJSER) published a paper in October-2015. Titled "IMPROVING PRODUCTIVITY IN FEED MIXING MACHINE ".This paper was published by Prof .AbdulrahimAbdulbaqi University of Maiduguri. The study was made for mixing grain, feed supplements other animal feeds to produce homogenous mixture. This was always been done by hand & sticks etc. But the advancement in technologic has brought automated machine which does the same work more efficiently in less time & less energy consumption is done. The mixing of feed to form a uniform ration is a regular need on large stock poultry purposes. The mixing is performed by a vertical shaft which revolves continuously in a cylindrical cone suspended by an iron bar. The relative motion of the shaft about the frame (body) is achieved by the use of knuckle bearing. Mixing is done in the mixing chamber. The mixer is constructed to take a capacity of 30kg, but the excess capacity of40kg was provided to take care of overloading , this machine was powered by 3hp power motor.[(IJSER) Volume 6, Issue 10, October-2015].
- Titled "SIMULATION & DESIGN OF MIXING MECHANISM IN FERTILIZER AUTOMATED PROPORTIONING EQUIPMENT". This paper was published by College of Engineering China Agricultural University,17 Tsinghua East Road ,Beijing, 100083 P.R.China. Precision agriculture is the developing trend of mordone agriculture , and the rotational utilization of fertilizer is one of the key technologies in the precision agriculture , Thus proportioning equipment is developed to proportioning three fertilizer i.e. Nitrogen fertilizer, Phosphorus fertilizer and Kalium fertilizer .The Proportioned fertilizers are spread into the soil after being mixed sufficiently. This result proper proportionate mixing.

- International Journal of Scientific Development and Research (IJIREM)) published a paper in November-2016. Titled DESIGN OF PORTABLE FOUNDARY SAND MIXTURE". This paper was published by Kaburu, Michael Kimani, Owino, George Omollo, Chirchir D. K , Dept. of Industrial and Energy Engineering, Egerton University, Nakuru, Kenya. Molding sand mixer is an effort towards mechanization of sand preparation in a foundry workshop It's used to evenly and uniformly mix foundry sand with binders and water in given proportions to attain the required state and moisture. The overall objective of the project was to design, fabricate and test a portable foundry sand mixer which is affordable and locally manufactured and assembled using less power for small scale enterprises in the field of foundry engineering. The design can be manufactured locally and sold at a price of about Ksh. 25,000 to Ksh 30,000 as the materials are locally available. The mixer is best suited to small scale entrepreneurs and colleges workshops where energy is not guaranteed all the time.

OBJECTIVES

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1. Design Development & kinematic analysis of wobble linkage and stirrer mechanism with estimation of torque and power requirement for mixer.
2. Test and trial on the mixer for production of 3.0 litres of ferrous oxide paint.

a)Reduction in cycle time of mixing
b) Improvement of viscosity and spread-ability

c) Productivity improvement owing to use of developed system

WORKING

When the motor is started it rotates the worm shaft by means of the muff coupling, it thus drives the worm gear which rotates the worm gear and the worm gear shaft bout the bearings. The rotation of the worm gear is transmitted to the kneader shaft which revolves about the worm gear axis but as it is constrained at the Hooke's joint which acts like an follower link with an cylindrical pair in the frame, it oscillates as well as reciprocates in the frame there by imparting an wobbling action to the spatula mounted on the end of the kneader shaft.

This wobbling action of the spatula in the tank virtually lift the dough and then presses it down which is an exact replica of the motion as done while kneading with hand.

Water and ingredients are added wile machine is in running condition to achieve the desired consistency and quality of the kneaded dough

DESIGN METHODOLOGY

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

- System design
- Mechanical design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; height of m/c from ground etc.

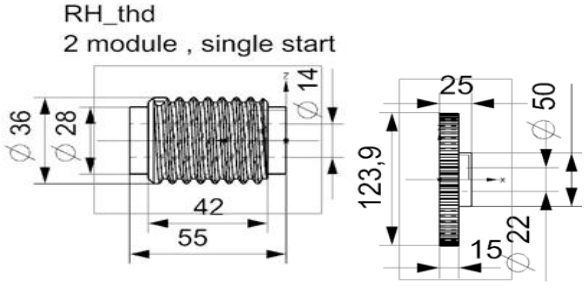
In Mechanical design the components are categories in two parts.

- Design parts
- Parts to be purchased.

For design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are readily available in market this simplifies the assembly as well as post production servicing work.

The various tolerances on work pieces are specified in the manufacturing drawings. The process charts are prepared & passed on to the manufacturing stage .The parts are to be purchased directly are specified &selected from standard catalogues.

DESIGN OF WORM AND WORM WHEEL



- The pair of worm and worm wheel used in the machine is designated as
- 1/60/10/2
- The worm is made of case hardened steel 14C6 where as the worm wheel is made of Cast iron.
- Z1 = 1
- Z2 = 60
- q= 10
- M=2
- I = z2/z1 =460
- N = 1900 rpm

  N2 = 1900/60 =31.66 =30 rpm approx
- Tangential tooth load = Wt = T/r = 15120 /60 =252 N
- Now strength of worm gear is given by ,
- Wt = σ Cv b π m y

  Where ,
- σ = 84 Mpa
- b= 15mm
- m= module =2mm
- y = form factor = 0.124 -(0.684 /Tg) = 0.1126
- Cv = 6 /(6 +v) = 6 /(6 + 3.142) = 0.656 ----(v = 2πN/60)

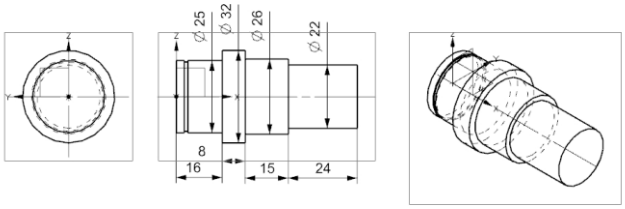
σ act = 252 / 0.656 x 15 x 2 x 3.142 x 0.1126 = 36.19

as , σ act < σ allowable

DESIGNATION	ULTIMATE TENSILE STRENGTH N/mm2	YEILD STRENGTH N/mm2
EN24	800	680

Thus the gear is safe .

DESIGN OF WORM WHEEL SHAFT



MATERIAL SELECTION : -Ref :- PSG (1.15) + (1.17)

- Þfs allowable = 0.18 X 800=144 N/mm2
- Þ T design = 15.12 Nm
- This is the allowable value of shear stress that can be induced in the shaft material for safe operation.
- Check for torsional shear failure of shaft
- Te = Π fs d3

  16
- fs act =16 x 15.12 x 10^3
- Π x 22^3
- fbact = 7.23 N/mm2
- As; fs act < fs all
- Worm wheel shaft is safe under torsional load.

CONCLUSION

The process of mixing through turbula shaker-mixer was developed and process was optimized using the technique. Turbula mixer are also used wherever minimum mixing time together with fulfilment of the highest homogeneity standards required in all industries. As this method is more efficient then the conventional method which also reduce stress of labour work.

FUTURE WORK

By changing the material of stirrer and using more high power of motor we can use our machine in food industries, pharmaceutical industries

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