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Double Helical Spiral Mixer

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Abstract: ***Recent advances in mixer and blender designs have contributed to the growing success of food companies, meeting their requirement for consistency and developing new products while also lowering production costs. This paper discusses both traditional and new specialty mixing technologies available to food manufacturers today. Phase and viscosity are used to classify different mixing categories. Sample applications are presented as well to illustrate certain processing challenges and the mixing technologies used to resolve them.[In conventional method of mixing the metal oxide powder and vehicle mixing is carried out on 'Unidirectional Stirring Machine' The stirrer of conventional machine rotates in one direction only which creates a particular flow pattern in the fluids hence the particles tend to stick to the walls of container owing to the centrifugal force rather than mixing thoroughly in mixture of paint, ultimately results into poor quality mixture of paints there by poor quality output of paint]***

Keywords: Spiral Blades, Bidirectional Motion, Pneumatic Ram, Planetary Mixer.

I. INTRODUCTION

Process industries like chemical plants, food processing plants, paint industry etc .largely employ mechanical mixers To carry out mixing of powders, semisolid jelly fluids. 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 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, so we make bidirectional mixer which move opposite direction in one cycle.

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For that motion we used the crank and fork mechanism, which form the turbulence in mixer and make homogeneous mixture. At the heart of transforming raw ingredients into food for human consumption is the mixing operation. One of its main tasks, which other food processing steps also share, is to establish consistency. Whether a food product requires small-scale mixing by hand or high volume blending of multiple ingredients, at-home cooks and process engineers alike know the importance of proper mixing. Even with the right amount of ingredients and flavors, a great recipe will not transform into good food unless the components are well-mixed. Taste, texture, color, appearance – these are all crucial parameters intimately influenced by the mixing process. Consumers expect that the food products they patronize will be exactly the same as the one they had last.

It is easy to understand that within the food industry a high level of consistency is required not just batch-to-batch but facility-to-facility. In this market, consistency is the backbone of consumer loyalty. Various types and styles of mixing equipment are utilized within the food industry. Their use and application are determined by the phases being mixed (liquid-liquid, solid-liquid, or solid-solid) as well as physical characteristics of the end product (like viscosity and density). In reality, many mixing technologies overlap in use and function such that certain applications can actually be successfully produced by two or more types of mixing systems. In these situations, economics rule out the more costly initial investments, but differences in efficiencies must also be taken into account. Proper mixer selection is vital to process optimization.

1.1. Objectives

1) To make a double helical spiral mixer which is applicable to all industries such as pigment, dye, pharmaceuticals, chemical, food, cosmetics, battery, pesticide, construction material, and plastics granule manufacturing.
2) To make a double helical spiral mixer for different raw material and particle sizes with highly efficient and excellent processing time.
3) To design and manufacture double helical spiral mixer for low energy consumption

1.2. Types of Mixer

1.2.1. Conical Screw Mixer

Conical screw mixer is a highly efficient and low energy consumption vertical mixer for powder and granule mixing applications. Various particle size materials can be mixed in the conical screw mixer. The screws and screw arms driven by motor and reducer, both separately move at different speed.

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Screws revolve on its own axis driven by a bevel gear, which elevates the raw materials upwards from the mixer bottom causing same material to fall downward by gravity. At the same time, the screw arm revolves around the central shaft to keep the materials rotating in the mixer. The whole mixing forms a three-dimensional action; where raw materials are sheared and diffused repeatedly in the vessel. The mixture, thus, achieves optimum homogeneity.

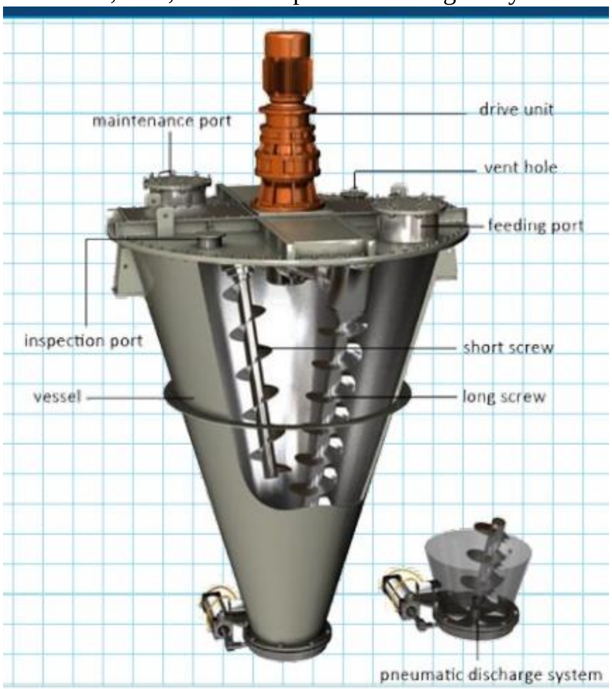

Fig.1. 2D View of Conical Screw Mixer.

1.2.2. Planetary Mixer

A planetary gear system will not assemble unless the number of teeth for each gear is selected properly. Once the design requirements are specified, the remaining parameters must be calculated to create a working configuration. Let'ssay the desired gear ratio is 5:1. This means the sun gear must make 5 revolutions for each revolution of the output carrier (Note: this assumes that the sun gear is the input, the planet gears drive the output carrier, and the ring gear is stationary. Other configurations are possible depending on the application). One more design requirement must be specified to do the remaining calculations. Let's say the sun gear must have 24 teeth.

Plugging in the known values, we get solving for Nr, we find that the required number of teeth on the ring gear is 96. We can now begin to solve for the number of teeth on the planet gear: Np: Number of teeth on the planet gear(s) Plugging in the known values, we get Solving for Np, we findthat the required number of teeth on the planet gear is 36. This is independent of how many planet gears are used. Note that the pitch of the gears is not specified. These equations hold true regardless of the pitch, but a pitch will ultimately need to be selected when designing a planetary gear system. Either the pitch itself will be a design requirement, or size limitations will be a factor, and the pitch can be selected accordingly.

A planetary gear system, also referred to as Epicyclic gearing, consists of three elements – a sun gear, one or more planet gears, and a ring gear. The sun gear is located at the center, and transmits torque to the planet gears that orbit around it. Both are located inside the ring gear. The tooth formation of the sun and planet gears is external, while the ring gear is internal. Planetary gear systems can vary greatly in size and configuration to produce a broad range of speed ratios and meet various design requirements. They are used in many different applications such as clocks, lunar calendars, car mirrors, toys, gear head motors and turbine engines.

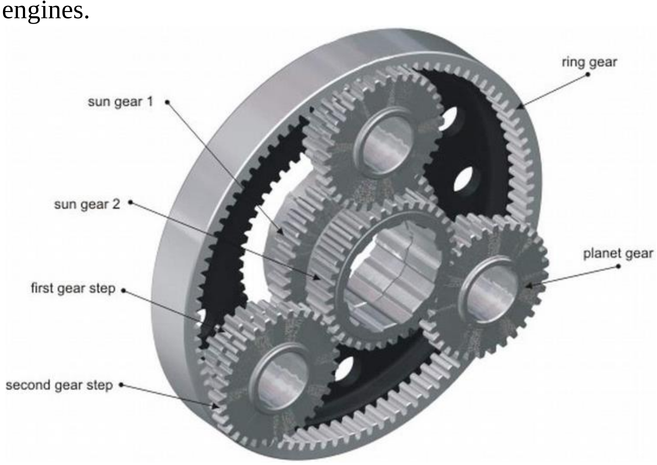

Fig.2. 2D View of Planetary Gear.

Fig 3. Planetary Mixer.

II. CONSTRUCTION AND WORKING OF DOUBLE HELICAL SPIRAL MIXER

A chemical mixer is being designed which consist of a container, impeller spiral blades, electrical motor, pair of pulleys, pedestal bearings, pneumatic rams, timer, solenoid valve and drive shafts. We are using the container made up of stainless steel; it is placed at about 6inches from ground, so that it is easy to pour the material for the workers preparing the chemical solution.

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The motor is placed vertically in order to mount the pulley and belt assembly on the motor shaft. This machine is designed to mix the cleaning solution used for cleaning the floors. In electrically powered system an electrical motor is used to run the motor shaft. As the motor shaft rotates, the pulley mounted on motor shaft also rotates.

The power transmission will be takes place from motor to impeller shaft. As the impeller shaft rotates the spiral impeller blades also rotate along the direction. Simultaneously the arrangements of pneumatic rams move up & down the head of driver to maximize the agitating performance as per operation of timer. Hence the mixing of chemical ingredients is obtained. The concept model of mixer is as shown in fig no.4

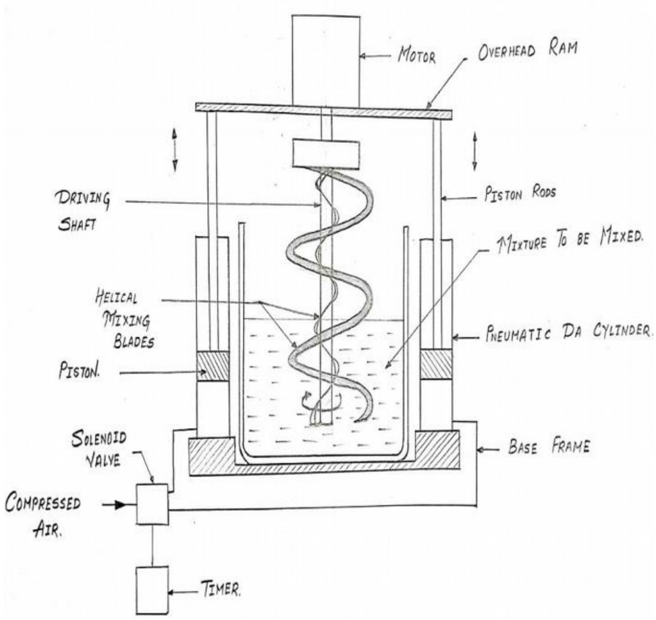

Fig.4. Praposed Model of Mixer.

2.1. Advantages and Limitations

2.1.1. Advantages

1) Optimal mixing homogeneity
2) Short mixing time
3) Excellent reproducibility of batch production
4) Minimum wear and low maintenance
5) Easy access to mixer/ Easy to cleaning
6) Excellent mixing at any product level
7) Low power consumptions

2.1.2. Limitations

1) The machine develop by us is having capacity only 20 liters, which can be made only to prove model's reliability or change in functionality for model synthesis. It is not an actual production model, but fulfills all basic requirements.
2) The machine develop by us is having small capacity of motor, so that it cannot be use large quantity of chemicals or liquid.

2.2. Applications

1) Chemical Industry
2) Pharmaceuticals Industry
3) Food Industry
4) Animal Feed
5) Metallurgy
6) Construction Material
7) Ceramic Powder
8) Mining Industry

Fig.5.Mixing of Multiple Color Paint in Paint Industry.

Fig.6.Mixing of Metallic Powders in Pigment in Preparation of Ionic Paints.

Fig.7. Can be used as Skimming Machine for or Creams, Lotions, Toothpaste, Gels, Ointments etc.

Fig.8.Mixing Applications in Pharmaceutical Industry.

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III. RESULT

By conducting test on Double helical spiral mixer following results are obtains, in which three liquid of standard viscosity range are use in centi-poise. And time is calculated in two machins (old and double helical spiral mixer) and plots are draws

3.1. Standard Range of Viscosity

In the test of water and milk adding 1cps water and 2cps milk, we take reading for both old and new mixer.

A. Water =1cps
B. milk =3cps
Take milk =2cps
cps = centi-poise

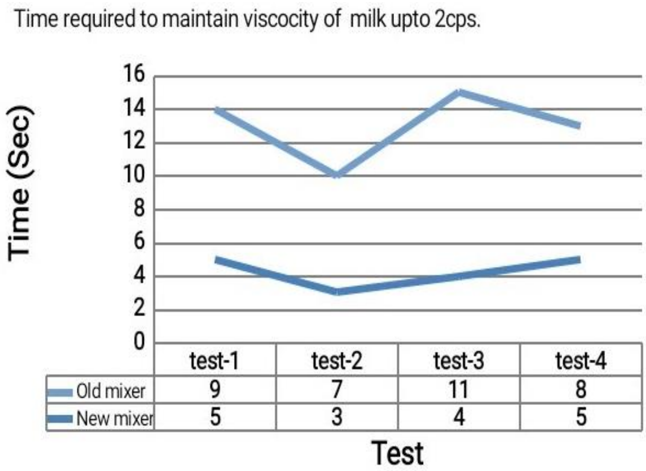

Fig.9. Time Required to Maintain Viscosity of Milk Up to 2cps

From the above graph it is observed that time required for mixing of water and milk is less (approximately 14%) as compared to old mixer in all tests.

3.2. Standard Range of Viscosity

In the test of water and ink adding 1cps water and 500cps ink, we take reading for both old and new mixer.

A. Water = 1cps
B. Ink = 550-2200cps
Take ink = 500cps

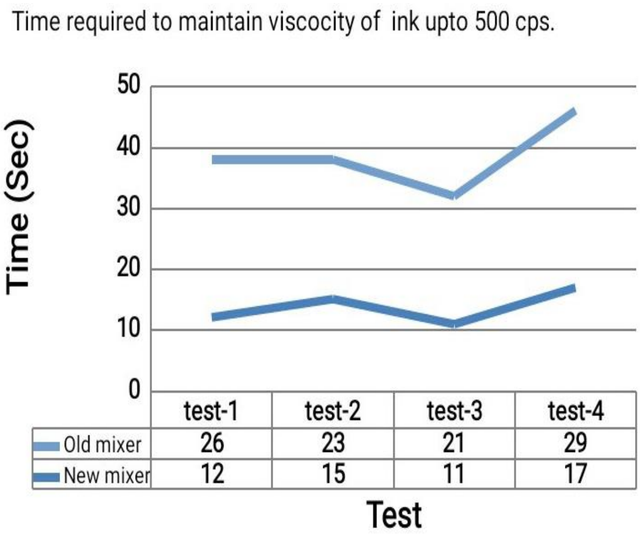

Fig.10. Time Required To Maintain Viscosity of Ink up to 500cps

From the above graph it is observed that time required for mixing of water and ink is less (approximately 44%) as compared to old mixer in all tests.

3.3. Standard Range of Viscosity

In the test of water and soap solution adding 1cps water and 40 cps soap solution, we take reading for both old and new mixer

A. Water = 1cps
B. Soap solution = 82cps
Take soap solution = 40 cps

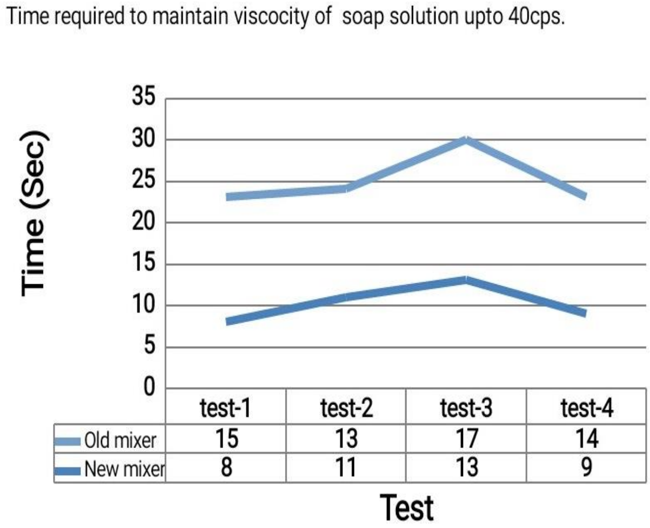

Fig .11. Time Required To Maintain Viscosity of Soap Solution up to 40cps

From the above graph it is observed that time required for mixing of water and soap solution is less (approximately 18%) as compared to old mixer in all tests.

IV. CONCLUSION

The Model Develop by us used 60rpm motor for 20liter capacity of mixer. In this mixer two helical spiral blades are used for mixing hence time required for mixing is less as compare to existing models of mixers. This mixer is used for liquid and semisolid product mixing.

These models fulfill the required objectives that it reduces human efforts & time in mixing operations. Similarly it maintains the accuracy in chemical mixing process. It performed the most rigid operation with high speed chemical mixing in any types of liquids. After some modifications in this machine develop automation unit for the mixer so that machine can easily be adopted in today's automated plants.

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