

## Design & Fabrication of 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 white 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 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.

In order to have a homogeneous mixing would be appropriate to make this process a dynamic process by incorporating the two set of spiral blades making it a spiral mixing machine resulting into thoroughly mixed paint mixture preparation which will create the good quality of mixing.

**Key Words:** Unidirectional stirring, Homogeneous mixing, Spiral blades, Bidirectional Motion, Dynamic process., etc.

### 1. INTRODUCTION

#### General

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, so we make bidirectional mixer

which move opposite direction in one cycle. For that motion we using the crank and fork mechanism. Which form the turbulence in mixer and make homogeneous mixture. Mixing is one of the qualities of the product.

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 Necessity

In this market, consistency is the backbone of consumer loyalty. Various types and styles of mixing equipment are utilized within the food industry. 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. Hence mixing of multiple colour paint in paint industry. Mixing of metallic powders in pigment in preparation of ionic paints. Can be used as skimming machine for creams, lotions, toothpaste, gels, and ointments.

## 2. LITERATURE REVIEW

For the manufacturing of a Double helical spiral mixer we refer various literature, papers etc. The review of previous method used given below: Suraj P. Mail et al. (2016) proposed that now a days cleaning has become most important part in Hospitals, Educational institutions and industries. This paper describes about the mechanical design and analysis of mixer on the fluid that is to be stirred in the mixing vessel. As we all knew that mixing is a very important processing any chemical, paints and food process industry. To attain the uniform mixing of the solution with the desired quality and in order to remove the drudgery of human folk this newly designed mixer is suggested. The cleaning department requires large amount of cleaning chemical solutions (phenyl) daily.

Siddhant Dange, et al (2016) this research paper aims to study the various types of concrete mixers, discuss the advantages of the planetary concrete mixer over all the other type of mixers, and study the various components of the planetary mixer in detail. The mixing is certainly the most critical phase of the concrete production process and the quality of the concrete depends heavily on the quality of the mixer. Due to the efficiency of the compulsory mixing action, the planetary mixers meet the requirements of various production processes. The mixing flow is highly efficient due to integrated action of central stars combined with different peripheral scrapers.

Raghunath Rajput (2015) presented the properly mixing of the fluid in mixing vessel.

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. In order to have a homogeneous mixing the directions of rotation of stirrer shaft which rotated stirrer blades in opposite directions in one cycle which formed turbulent flow pattern there by leading to creation of irregular flow pattern and resulting into thoroughly mixed paint mixture preparation which created the good quality paint.

S. N. Waghmare et al. (2015) here they have discussed various views from their study on different topics. They say mixing process has been performed which conform that the proposed mixing prevent the formation of segregated region hence shorten the mixing time than other mixing method. Also he said that by using the bidirectional mixer in container create turbulent flow of mixture and we get the homogenous mixture. The cleaning department requires large amount of cleaning chemical solutions (phenyl) daily. Mixing of chemical solution can be defined as to create or form solution in the form of liquid by combining ingredients. This mixer is been designed and fabricated for mixing of chemical solution, which is used to for cleaning purposes in educational institutes, offices, hospitals, large shop floor industries etc.

This type of chemical mixers are used in process industries like paint industries, chemical industry, food processing plants etc. They are mainly employee for mixing of powders, chemical solutions semisolid fluids etc. This paper Proposed work of a chemical mixer. This work was undertaken considering reducing human efforts in small scale and institutional level. The conventional method of preparing cleaning solution is replaced by the "bi-directional electrically powered mixer" by using this we can stir large amount of various types of chemicals used.

Charles Ross & Son Company (2015) presented an overview of mixing technologies implemented across many of today's highly competitive pharmaceutical and medical industries, as well as new equipment designs that are increasingly being recognized as potential solutions to prevailing mixing challenges. Mixing applications falling within the broad spectrum of mass produced pharmaceutical goods and medical devices are too many and complex to discuss in detail hence this paper will touch on a few general classifications as well as a few examples within that mixing category.

Osokam Shadrach ONYEGU et al. (2012) this paper presents the design and fabrication of a poultry feed industrial tumble mixer. The design computations to handle a 50Kg mass of feed was done in the MS Excel environment for proper machine design approach. The machine was designed using AUTOCAD 2D/3D design software and proper material selection was done before the assembling and fabrication of parts. Proper design analysis was carried out on the machine to avoid failure on both the blades and the shaft

Helmut Brod, et al. (2011) The Invention relates to a device which comprises of 2 Rotating Agitators, at least one of those being a Helical or Anchor Agitator arranged centrally in the housing, and at least one of the other agitators being an eccentrically arranged screw or Blade Agitator. A mixer having improved axial and radial mixing which retains good mixing time even during large viscosity changes, comprising a housing with at least one helical located centrally in the housing in combination of a helical

Energy source especially for gas based source of power .But our lawn cutter is not based on solar because of its cost and create some complexity during working. So we avoided solar powered lawn mower. In this hydrogen based lawn mower, the advantage of powering a lawn mower by hydrogen rather than by gaseous material is mainly ecological. We don't use this for our lawn cutter because it is very old method and many overcome produced from this type lawn cutter.

### 3. PROJECT METHODOLOGY

#### Block Diagram

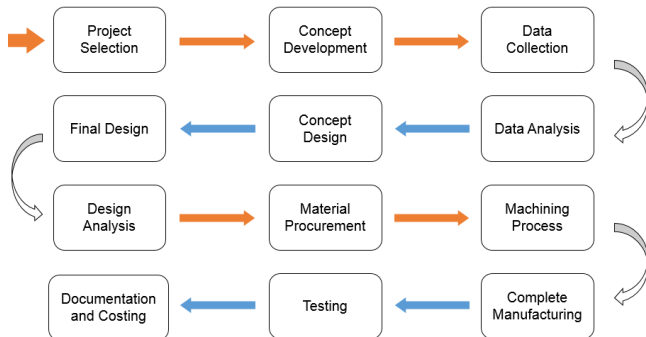


Fig.1: Processing Steps

### 4. Construction and Mechanism

#### Working Principle

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. 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.

- o **Planetary Mixer Mechanism**

Industrial Mixers and Blenders are used to mix or blend a wide range of materials used in different industries including the food, chemical, pharmaceutical, plastic and mineral industries. They are mainly used to mix different materials using different types of blades to make a good quality homogeneous mixture. Included are dry blending devices, paste mixing designs for high viscosity products and high shear models for emulsification, particle size reduction and homogenization. Industrial mixers range from laboratory to production line scale, including, V Blender, Cone Screw blender, Double Cone Blender, Double Planetary High Viscosity Mixer, Counter-rotating, Double & Triple Shaft, Vacuum Mixer, Planetary Disperser, and Dispersion Mixers, Mobile Mixers and Drum Blenders.

Mixing fulfils many objectives beyond simple combination of raw ingredients. These include preparing fine emulsions, reducing particle size, carrying out chemical reactions, manipulating theology, dissolving components, facilitating heat transfer, etc. So even within a single pharmaceutical product line, it is not common to employ a number of different style mixers to process raw ingredients, handle intermediates and prepare the finished product.



Fig.1: Planetary Mixer

### 5. Machine Components

#### 1. Planetary Gear

A planetary gear system will not assembled 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's say 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. The other parameters can be found using the following equations:

R: Gear ratio, to 1

Nr: Number of teeth on the ring gear

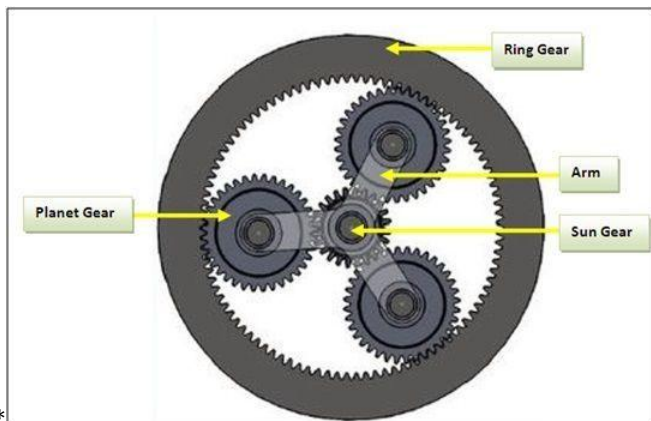
Ns: Number of teeth on the sun gear

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:  $N_p$ : Number of teeth on the planet gear(s) Plugging in the known values, we get Solving for  $N_p$ , and we find that 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. The following table gives an example of the gears used in a particular planetary system, with all specifications included: Sun Gear Planet Gear Ring Gear.

Quantity 1 3 1  
 Module 1 1 1  
 Number of Teeth 24 36 96  
 Pressure Angle 20° 20° 20°



### 2. Motor

This is an electrical motor which runs on 60rpm speed. It is mounted on the upper head of the machine. On the motor shaft a smaller pulley is mounted and the motor transmits the motion to the larger pulley by means of the belt drive. And it helps to rotate the shaft and it automatic rotate the helical spiral stirrer and it mixes good quality mixing material.



### 3. Pedestal Bearing

This bearing is fixed in the upper two plates to accommodate the shaft in it. It makes the rotation of the shaft smoother and also helps in reducing the vibrations and frictional heat and damage to the components.



### 6. Product Description

Sr. No.	Parts	Quantity
1.	AC Motor	1
2.	Pedestal bearing	2
3.	Shaft	1
4.	Bush	8
5.	Nut And Bolt	8
6.	Tank	1
7.	Frame structure	1
8.	Spiral Blades (Opposite Hand)	2
9.	V-Belt	1
10.	Pulley	2
11.	Double acting Pneumatic cylinders	2
12.	5/2 Solenoid valve	1
13.	Pneumatic fittings	8
14.	Pneumatic hose pipe	5

### 7. Advantages

- Stirrer has bi-directional i.e. it rotates in both directions; this gives uniform mixing.
- Quality of mixing is very high.
- Low cost of mixing.
- Fast production rate.
- Compact size so minimal space requirements.
- Low power consumption.
- Optimal mixing homogeneity
- Short mixing time
- Excellent reproducibility of batch production
- Minimum wear and low maintenance
- Easy access to mixer/ Easy to cleaning
- Excellent mixing at any product level
- Low power consumptions

## 8. Disadvantages

- The machine developed by us is having capacity only 20 litres, which can be made only to prove models reliability or change in functionality for models synthesis. It is not an actual production model, but fulfils all basic requirements.
- The machine developed by us is having small capacity of motor, so that it cannot be used large quantity of chemicals or liquids.

## 9. Applications

- Mixing of multiple color paint in paint industry.
- Mixing of metallic powders in pigment in preparation of ionic paints.
- Can be used as skimming machine for creams, lotions, toothpaste, gels, and ointments.
- Chemical Industry
- Pharmaceuticals Industry
- Food Industry
- Animal Feed
- Metallurgy
- Construction Material
- Ceramic Powder
- Mining Industry

## 10. CONCLUSIONS AND FUTURE SCOPE

Till now we carried out the market survey of the mixer visiting the Industry and taking into the consideration the existing components and mixers in the industry then we also found out the problems faced by the personnel while carrying out the mixing process and then took those all into consideration while designing the new modified mixer. We have completed the design of the mixer till date. We referred certain research papers related to our topic which are mentioned in the literature review of our topic and also we have provided their references. The work we completed now was on the design side of the project which contained the numerical analysis of the mixer and its supporting literature survey. From this work we concluded that the mixer we are designing solves a few problems of the conventional mixers. From hereby we have planned the detailed activity scenario as to how it is going to proceed. In the upcoming days we will be carrying out the activities such as load calculations, analysis of the component against the calculated loads, finding the factor of safety for the entire components, here we will be undertaking the analysis of the project design by taking into consideration the real time operation of the mixer. Then we will be sure on the design calculations we have made and then we will be sure to fix the dimensions of the mixer as decided. Hereby we conclude that we are in the mid stage of the project and we need to focus on the detailed activity chart we

have prepared and hence shall proceed towards the project work accordingly.

### Future Scope

- The model prepared was a scaled model. It was prepared for 20 litres capacity. This model after being tested successfully was decided to apply for a larger scale model in the industry. In the upcoming future the certain modifications in the model can be made and can be applied for more widespread applications. This model can also be used with a hydraulic circuit in order to handle the higher capacity model with larger volumes of the tank.

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