


Original Article: Design of Hybrid Mixers in the Petrochemical Industry

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ABSTRACT

Process mixers and reactors are customized equipment with different capabilities that are designed and built for different pressure and temperature conditions according to process requirements. This equipment is available in atmospheric, pressure and vacuum, single-wall, double-wall and triple-wall types. The design and construction of these mixers is based on the latest standard editions of the American Society of Mechanical Engineers (ASME) and the use of up-to-date mixer technology and the creativity of the creativity of experienced mechanical engineers and (Pharmaceutical Equipment Department of mechanical engineers' group - Petromana). According to the needs of these mixers and reactors, they can be used in various chemical, food, sanitary, cosmetic and pharmaceutical industries. Also, considering the necessary requirements in designing and manufacturing, injectable drugs are also widely used. All types of reactors and fermenters can be produced in the family of these products. All industrial mixers have a mechanism similar to a simple household device, they all have a power generator, power transmission, blades and a container for storing materials. Only in some types, the blade type changes depending on the ingredients that are to be mixed. The material input is a constant flow, just like a river with a very calm surface and a very turbulent depth. The liquid surface remains constant and does not mix well. In this situation, we have no choice but to change the type of blade. The available options are to design the same shaft in the liquid surface and increase the number according to the need and length of the shaft, for example, design the same shaft in the middle of the liquid, but what if the liquid becomes denser and thicker? On the other hand, adding the number of blades fills the volume of the tank and leaves less space for the main materials. In this study, hybrid mixers have been investigated.

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Introduction

In industrial design, this system is used when we are faced with the problem of pressure, when the materials put a high pressure on the vane during mixing. Here we use hydraulics, with this system, high pressures can be produced even up to 100 bar. Sometimes our product is faced with a substance that does not need much force to stir at first, but during the process, our substance becomes thicker and the stirring force increases. This system requires a hydraulic mechanism. Most of the time, hydraulics is the answer, its only drawback is its high cost, and the cost of its repairs is also expensive, in addition to its accessories, such as oil forms, hydraulic motors, felt bowls, bearings, pumps, and electric motors, etc., but in general, it is a reliable system. However, it can be directly connected to the output of the hydro motor and installed on the tank, or the vane can be connected to the gearbox and then to the hydro motor [1].

There are many ways to install it, which depends on the designer, but usually the vane is attached to the shaft inside the tank. They connect and then connect the shaft to a gear box or gearbox and then connect the gearbox to the output of the hydro motor and finally a strong system is prepared. It is the same in the pneumatic system, only our power is much less and they use this system when the fluid creates a small force against the movement of the blade. Wind motors are usually variable speed and are directly connected to the blade and determine the output speed by adjusting the screw [2].

It should be noted that experience is always the first word. A set may be well designed in theory, but it is poorly made in execution and does not work. All parts of a set, from the theory stage to the implementation, must be coordinated and calculated so that the set can work properly. It works slowly, sometimes the system fails many times to get the desired result. For each collection, it is necessary to spend money and gain experience. Experience is the guarantee of the success of a product. A product without experience has little chance to achieve results.

Electrical Systems

In most cases, this mechanism is used and the weak power is strengthened by the gearbox, and due to the cheapness of electricity and its abundance and availability, most designers use these systems. The necessary power to rotate the vane is produced by this system. We can connect all kinds of vanes to this mechanism, but first of all, we must pay attention to the number of revolutions of the electric motor and the type of amperes it draws. The type of motor may be single-phase or three-phase. It is usually used in the three-phase industry [3].

The purpose of this discussion is only to create a view around the big world of mixers, not to introduce them all, the purpose is only to get to know this industrial family, so that in the following discussions, we will discuss the main mechanism presented in this project. Therefore, an attempt has been made to summarize the contents and the contents are intended to give a brief introduction to the large group of mixers. In some mixers, it can be seen that the tank also has a rotational movement, i.e. the blade is fixed and the tank rotates, or the blade is fixed and rotates in its place and outside the main axis, and the tank has a rotational movement. However, the designs are different, in some cases we have two or more main rotating shafts that all mix the material inside the tank together. Anyway, as the number of axles increases, the design becomes much more difficult and difficult, and naturally, it becomes more difficult to create power to move them, and most importantly, connecting these shafts together, making bearings, and overall control becomes more difficult [4].

The best solution is to use mechanisms with a shaft or axis, but as we said before, it is the material and its conditions and properties that force us to design the system. It should be noted that hydraulic systems work very smoothly and quietly and muffles sudden shocks and ultimately does not put pressure on the system and increases the durability and life of the mechanism, but pneumatic systems are usually very noisy and need a muffler. By the way, vibration is the basis of the work of these engines, because their engine works due to the impact of air on the blades, so even a very small vibration is always present in these engines. But

why these engines are used, why electricity is not always used, why sometimes wind and sometimes hydraulics are used [5].

The question is why we don't always use a powerful gearbox with an electric motor and we don't remove the rest of the mixers from the world of industry. In the answer, it must be said that it is true that this electric mechanism is always the answer, but sometimes there is a safety issue, that is, our environment has special conditions. Conditions other than the conditions of mixed materials. Suppose the working conditions are contaminated with gas and there is a risk of explosion. Here, electric motors are extremely dangerous. Or suppose you work in the food industry, you know that hydraulics is sometimes associated with oil leaks, and oil leaks mean disasters and whatnot. Some consumers may be poisoned. Even pneumatic contains a little oil in the compressed air, or even the air itself has moisture, which itself cannot be the cause of the transfer of thousands of bacteria and microbes. Anyway, a set of these issues has caused a great variety of these products. The said material tried to introduce and introduce different types of mixers, it is hoped that it has been able to provide the basis for the continuation of the discussion and presentation of the main content of this project. Anyway, any defect and deficiency in clarifying the content is caused by the inability to convey the content correctly. I hope you will overcome this defect.

System Description

The previous material provides a brief introduction about mixers, now we have to check the working conditions and environments once again, in the previous chapters, solutions were presented to solve the problem of the blade and the shape and design of the blade in dealing with the fluid and materials inside the mixer. Now suppose that the shape of the blade is not very important. Suppose the situation is different. Suppose we are facing a stressful situation. More clearly, our process is completed during a condition or application of pressure, for example, imagine a pressure cooker in the kitchen, which is supposed to stir the ingredients inside. The smallest loophole in the system means a big flaw. Our work conditions

are much more stressful and the tank is much bigger. The maximum pressure inside the kitchen pressure cooker is 5 to 6 bar and its volume is 0.2 cubic meters, our working conditions work with a normal pressure of 25 bar and a maximum of 90 bar, that is, at least 25 bar and the volume of the tank is 1.5 cubic meters, all tolerances, shaft and tank, where the main shaft passes through the tank is considered a big hole. These tolerances prevent pressure build-up. As a result, we cannot produce the desired product [6].

What is the solution?

If we choose the tolerance of the shaft and the body more carefully, the shaft will not rotate at all or the engine will be pressured and its life will be reduced. What system should we use, what solution do you offer? First of all, it is necessary to mention that all the previous systems are inefficient and do not respond to this problem. Using felt bowls, packing, O-rings and similar things is not an answer, the pressure is very high, maybe these things work at a pressure of 2 to 3 bar, but at a high pressure, especially above 10 bar, it is not an answer. It should be noted that it is better to refer to the thermodynamic table and its relationships. According to the table and P-T diagram, water boils at 99.6 degrees at a pressure of 1 atmosphere, close to 100 degrees. Now let's assume that the pressure increases, naturally the temperature also increases, according to the table, at a pressure of 22.09, the temperature of water reaches 374.14 degrees, which means that the temperature required for boiling water reaches this value, so with some estimation, we can say that at a pressure of 25 bar, the temperature is reaches 400 degrees, this heat melts any type of felt bowl of any rubber material. No rubber can withstand this temperature [6].

So the situation becomes more difficult and the problem a little more difficult. We need to design a mechanism to solve this problem. In addition, it should be efficient in the long term and all issues should be considered, which means that our system should be stable and have a good reliability factor. The described conditions, including pressure, temperature, and the issue of sealing the tank to increase the pressure, etc.,

can make any design difficult. This situation occurs in the industry, especially new industries, of course, it is new for our country, and there is no other choice but to deal with it. We must face these problems and think of a solution. What solution do you suggest? How to solve the sealing problem? How to raise the pressure? How to control the temperature? In this high temperature, what solution should we choose so that the bearings work properly? You can see that in a shaft diameter of say 60 mm we have about 3% mm increase in size. That is, with this increase in size, all our bearings will be locked and will not work and will hold the shaft like a clamp. We also know that the bearings themselves have a tolerance of a thousandth of a millimeter and all the bearings get stuck at this temperature. You can see how complicated and problematic a simple home mixer becomes in industrial conditions. First, the solution is said in general, then its details are discussed. For the release and leakage part, we must assume that our system is completely enclosed in a chamber and room, that is, we should put a metal box on the whole system and then close the door tightly, of course. This is just a simple description to give an overview. Now, the solution of cooling and lowering the temperature is suggested for the better functioning of the bearings, and again the question is raised, in what way? How to lubricate mechanical components and friction surfaces, different solutions can be used for this purpose: 1- Reducing the temperature by creating an air flow in the form of blowing air by industrial blowers and fans into the working environment, and if the temperature is high, water can also be used for cooling and the environment can be cooled with cold water or even by using oil in this way. To design a system that circulates air, water, or oil around the work environment alternately. In our system, water circulates with 2 bar pressure and regularly, and at the end it cools again and returns to the system, which is the best solution to prevent water wastage. Economically, it is more economical. This part is used in our collection, and in our collection, the mechanism is cooled by water, place A is intended for entry and place B for exit. Pay attention to the parts where the bearing is used and see how cooling is done, cooling is done through conduction, all metals do this with a

different percentage, in some it is more like copper, it is better if this part is also made of copper. But due to the high cost of copper, its alloy and aluminum resistant to corrosion and pressure can also be used. Anyway, as long as the water circulates in the system, the temperature of the parts and bearings will never be higher than the temperature of the water, and the better the circulation and cooling, the lower the temperature will be and the parts will remain safe from damage. Low temperature is the guarantor of the health of our system and is of particular importance. Without cooling, this project is impossible to function and the project will remain unfinished [7].

Bearings

After the implementation and construction of the main part, which was the magnetic part, now we have to make the bearing of the axis and these magnetic parts. In the previous chapters, it was briefly mentioned about sealing and we got acquainted with this topic. Now we have to seal the axis based on the principle of sealing and no leakage of bearing materials. Bearings are not very important in the first stage, but in the construction stage, we realize the importance of this stage and that without its accurate implementation, we will not have a good system. Choose the type of lubrication. Shaft and bearing are two inseparable parts. Whenever we talk about shafts and axles, we will definitely come across some kind of bearing, here we have a special shaft that we must use bearings with special conditions for that shaft.

In this system, due to the possibility of continuous lubrication, we use bearings marked (Z) or (2Z) that do not need lubrication, as they are resistant to high temperatures and continue to work without lubrication.

Whatever factor we choose for the mechanical core, we need an electric motor to cover our working conditions to create the primary force. For example, the type of current, amperage and power of the electric motor and most importantly its circumference. The calculations related to the electric motor are described in the topic of mechanism design. Now, to complete the article, we will continue the discussion on power transmission from the electric motor to the

mechanical core. What is the best option for power transmission? It is better to review the options before choosing topics. We can use chain wheel, gear wheel, and belt wheel systems, each of them has its own advantages, but for our system, all three can be used. To avoid noise pollution, wheels and belts are the most suitable option. If the length and distance of the electromotor of the mechanical core is large, it is better to use wheels and chains, if we want a mechanism without backlash (at least backlash) and have good efficiency, the gear wheel has a higher efficiency compared to the belt wheel because it is possible to slip in a load effect in the pulley. Anyway, we can choose the best option by comparing work. Look at the mechanism figure on the next page, the general view of a power generator with a wheel and belt mechanism can be seen, with the difference that the views are not drawn in an exploded way and are more general. In this image, the goal is to transfer power from the electromotor to the mechanical core and finally to rotate the shaft. Depending on the transmission coefficient, we can use two or more rows of belts and minimize possible slippage due to extra load. It should be noted that the mechanism is not that simple and it also has control equipment, for example, if for any reason the shaft does not turn and gets stuck, there is a mechanism that cuts off the electricity and prevents possible damage to the electric motor or belt, etc. In the topic of design, we will also discuss these points and we will try to express them completely in the whole article and leave no ambiguity [7].

Mechanism Design

Here, we have to choose the allowable stress in such a way that it is equal to the tank stress, now we have to compare it with the final stress, if it is higher than that, our confidence factor will be reduced, which means that we will not reach the maximum pressure at all, and before the maximum pressure of our tank bursts if our stress is equal to the final stress, that is, the tank will burst when it reaches this pressure, so the stress of our tank must always be lower than the final stress. It means that its value should never approach this tension. Our pressure value, which is constant and we cannot decrease it, we cannot

decrease the volume of the tank, so somehow the radius of the tank is also constant, unless we increase the length of the tank, which is not the right thing to do. Because in this case, we have to increase the length of the shaft and the height of the tank and finally the whole system will increase. So, the only option is the thickness of the tank sheet. By increasing the thickness of the tank, we can finally minimize the stress. Pay attention to the example below and compare it with the actual value of the tank.

The tension in the tank

Assuming we increase the thickness
Assuming 2cm

The stress in the reservoir designed in the original sample project

It should be noted that in the case of the tank, when the calculations are done and the desired reliability factor is considered, the best non-destructive test modes should be performed on it. The more non-destructive tests, the longer the durability of the mechanism. Anyway, at least a radiographic test and a surface crack identification test should be performed on the tank. Radiographic test for the absence of cracks and holes inside the body or inhomogeneity and alloy grains in the body and surface cracks test which may be in the form of magnetic particles or powder grafting materials. Whatever we spend on the tests, we have saved on future costs such as human and financial damages caused by defects in the body.

Anyway, the tank is not limited to these issues that we have said, other details should be considered for the tank. Such as the parts for the entry and exit of materials, how to discharge the materials and the method of mechanical connections such as bolts and nuts and valves and most importantly the safety valve, our design was based on the maximum pressure. Let's rely on the calculations and besides this, it is not right to put high pressures into the tank. For this purpose, the valve tank must be reliable and act when necessary to prevent high pressure from being applied to the tank and ultimately reducing its life [8].

In addition to this, the tank must be equipped with temperature and pressure sensors and controllers that stop the process if necessary, for example, if the temperature or pressure of the sensors decreases, they activate the alarm system, and even in more advanced models, the sensors in addition to the mechanism alarm have a pressure and temperature controller and regulator without these components our tank is complete and have a pressure and temperature regulator without these components our tank is not complete and we cannot be fully confident about the project, at the same time by equipping the mechanism with these components we can reduce the human factor and we know that the human factor has a higher error rate than the machine. The design of the reservoir still needs more explanation, but our goal in this project is to get to know the components of the mechanism of this project at a preliminary level, of course, this information is sufficient for the construction and design of this mechanism and is sufficient in many cases, but always to obtain results and information. New will be useful for the development and improvement of a system, especially the mechanism of this project [9].

Electric motor selection

The main factor of power generation in this project is the electric motor, which should be chosen carefully. According to the shape of the design of the system and reviewing the previous maps, we have realized that the type of electric motor is in the vertical category in terms of work. If we choose an electric motor that is, for example, in the horizontal working group. It may work in the short term, but in the end we will not get the desired result and we have just wasted money and time. When choosing an electric motor, we should pay attention to several points. Each of the above factors has a reason for the ampere, round and type of phase for the individual, which we will discuss in detail. In the case of the ampere, you should pay attention to the electric motor plate because our system does not have a gearbox or a gear and a gearbox and... So, all the fluid pressure enters the electric motor, so we have to choose a powerful electric motor. In this system, our electric motor shows about 12 amps at the most, which can be

measured by an ammeter. It should be mentioned that in our working conditions, it usually draws 4 to 6 amps, and in critical conditions, when the amperage rises, there is a mechanism that is electric and cuts off the current like a fuse in the circuit, and activates the alarms and prevents damage. Prevents the electric motor. As it was said, the resistance of the materials inside the stirrer enters directly through the blades to the shaft and then to the belt through a pulley and finally to the electric motor, so first of all we must know what ampere to choose the electric motor. For this, the force that enters the blade must be calculated. This work can be measured in the laboratory by the density and concentration of materials. After calculating the force applied to each blade, we can choose the electric motor. Actually, calculating the force applied to each blade is a specialized task and requires special devices. We only need the area of the blade and the type of material. We give it and we use that value as a criterion in the design of the electric motor.

It should be mentioned that less time is produced in the process and not every heat is useful for us. We only consider the heat that has been calculated to be useful, the extra heat increases the cost of cooling, you may not believe it, but those who have experience using materials know that the movement of fluid produces heat. For example, a fluid may produce a temperature of 70°C when moving along a curved path of 2 meters in half an hour. This temperature is due to the collision of material particles, and the denser the fluid, the more complicated and difficult the collision and pressure. And the temperature also increases, now for cooling we need a pump, water, water filter, pipe lines and other equipment, so when we can save these costs by choosing and designing the right electric motor cycle, it is not appropriate that this action means designing and Ignore the correct selection of the motor speed. The next issue is the type of electric motor in terms of current. Two types of single and three-phase current are common in the industry, the single-phase type is 220 volts and the three-phase type is 380 volts. Each has advantages and disadvantages. The single-phase type has less power, but its energy source is available everywhere and is cheap and there is 220 V

current almost everywhere, but the three-phase type has high power, but it is an industrial power source and is only in industrial centers. There are workshops. In our system, due to the high power of the electric motor, we use a 3-phase current type with a current of 380 volts [10].

Selection of metals

The materials and metals of the set, according to the work situation and the task they perform, must be selected from a special material and metal, which we will describe in this section, and the reason for choosing these components with these electromotor poly metals is known to almost all those who have experience in the industry, who must whatever gender is chosen and it is part of public information, money should be chosen from cast iron. Because it has a lot of graphite and graphite has a high melting point and is resistant to wear and produces little heat due to friction, which is negligible, the tank must be made of metal, resistant to corrosion and pressure, the best option and the cheapest is steel or stainless steel. Do not rust or rust, of course, you can use alloy and corrosion-resistant aluminum, especially aluminum is more resistant to pressure than steel, and it is shaped like a tank. If we use a sealing gasket between the tank and the sealing folder, the material of aluminum should be soft, because it sinks into the unevenness on both sides of the part and completely seals the surfaces. In our tests, no metal other than aluminum has worked. All electric cables from the electric motor to the sensors must be resistant to shock, corrosion, and moisture and can have a long life span. In this project, any power cut means loss and additional cost, the cost of a good cable cannot be compared to the cost of the process failure. All bearings must be resistant to pressure and humidity and have maximum life in wet conditions, naturally, ordinary bearings will corrode quickly, especially in high pressures. One of the disadvantages of welding with an electric arc is that it changes the properties at the welding point and there is a lot of corrosion in these areas, so we should avoid manual welding except when necessary and as a last resort.

System maintenance and repair

It is the feeling of need that makes us think of new ideas, and finally, after the completion of the design, the construction of a collection takes place, but it does not always end with the construction of a project. In this system, like all projects, we need repair and maintenance. Our repair and maintenance items in this project include electric motor, pulley and belt, tank and other components. For example, in the case of the electric motor, it is to check and control its sound while working, and in case of unusual sound, it is to check the bearings and test its amperage. Anyway, no electric motor has a permanent life, it is better to do this on a monthly basis. In the case of silver and belts, it is necessary to check them and if there is a need to adjust the distance and replace the belt and maybe it is silver itself, sometimes corrosion is caused in metal and silver materials as a result of continuous work [11].

The tank should be checked continuously and successively in terms of corrosion and surface cracks and sediment removal and scaling, each of which is defined according to the process. Our main and important test that should be done every day is the leak test of the tank's watertightness, which can be by creating pressure with compressed air and testing the connections with the floor one by one, this test prevents accidents and spillage of materials due to the lack of pressure increase. The testing of sealed bearings in the watertight part is done by sound control by skilled people [12].

Conclusion

Mixers are generally used to multiplex signals with different frequencies in frequency transmission. Due to the fact that the incoming RF signals are very close and dense, we need a filter with a very high Q to filter the desired signal. But if the frequency of the RF signal can be reduced, it will be much more controllable among the down converted telecommunication systems. One of the best known down convert systems is the super heterodyne receiver. The two main components of mixers are mixer and revealer. The combiner can use a directional coupler with an angle of 90 degrees (or 180 degrees). Old detectors used a single diode as a

nonlinear element. But non-parallel double diodes and double balanced diode combinations are used more. In addition to diodes, MOSFET, BJT mixers are designed with low noise figure and high conversion gain in X band. But the problems that the super heterodyne receiver adds are:

The mixer and the local oscillator should be designed and the local oscillator should follow the nonlinear circuits in front of the mixer.

Because mixers often produce more noise than amplifiers and because they have nonlinear properties due to their nature, we definitely need an RF amplifier in front of the mixer.

It is clear that a linear system cannot fulfill all the tasks and we need to choose a non-linear device such as diode, FET or BJT that can produce the product of harmonics. Many processing units are starting to use mixers for processing. Mixing equipment can complete the process of mixing different materials during operation. Therefore, it is very important to use mixing equipment in pesticide and fuel units. Mixing processing allows different types of materials to be completely mixed in a short period of time. This mixing equipment can not only solve the operational problems of production, but also replace many traditional methods. Production technology and working methods of mixing equipment meet the needs of modern industries. Therefore, it pays more attention to manufacturers. When the mixer is installed, the material can be stable and thoroughly mixed, the mixing effect between the materials is sufficient, the equipment is not prone to failure during operation, and due to the advanced production concept, it is not necessary to use it often. Manufacturers reduce software costs. So that long-term use of mixed work units can reduce costs and reduce the economic burden.

When using the mixer, the energy consumption of the equipment is very low. Therefore, the user can use the minimum energy to achieve the ideal processing goal, when using mixed equipment for processing operations, which is more advanced than traditional processing equipment, and also meets the requirements of environmental protection and energy conservation. Therefore, hybrid equipment has helped the industry a lot and this equipment has started to receive more attention from the

industry. The operation method of the mixer is very simple and logical. The user usually only needs simple steps to complete the mixing process while using the mixer. The practical application of the mixing machine can provide a better foundation for the development of the production and processing field. The use of a mixer is very important in the processing industry of mixed and mixed materials, because the equipment can be mixed and processed for two or more types of raw materials as long as the staff ensures that the additional amount meets the standard when the raw materials are in equal proportions can be guaranteed. A complete mixing effect can be achieved, and during the processing of raw materials using mixing equipment, the physical and chemical interaction between materials can be completed, which provides more suitable conditions for production. In order to simplify the installation and use of the mixing machine and meet the requirements of real use, the user should pay attention to several selection techniques in the process of purchasing the machine.

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