DESIGN AND ANALYSIS OF HORIZONTAL CRYSTALLIZER FOR AGRO-CHEMICAL INDUSTRIES

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Abstract:

Industrial Crystallizer is a device in which hot solution is allowed to cool and form crystals. The process of formation of crystals is known as crystallization. Hot water from boiler is let into the crystallizer and chemicals are added so as to make the solution super saturated, as the temperature of the solution decreases the formation of crystals takes place and this is known as nucleation. Blades of the crystallizer rotates continuously so as to form even sized crystals. The function of the crystallizer is mainly to form crystals. The proposed project is to design a Horizontal Crystallizer. Horizontal crystallizers are used for batch production. These are mainly used in small to medium scaled industries. The Crystallizers has various applications in many industries especially in Chemical and food industries.

Problem Statement:

Conventionally, industries use Vertical Crystallizers, which facilitates for the easy removal of crystals during the process. The crystals which are produced do not have a mean size i.e., the crystals are not of even size, which requires further processing of crystals for making them finer. The proposed project is to develop a horizontal crystallizer, which will be used for batch crystallization process. The crystallizer will consist of single compartment with blades in it and it is a cooling crystallizer. The crystals are formed as the solution cools.

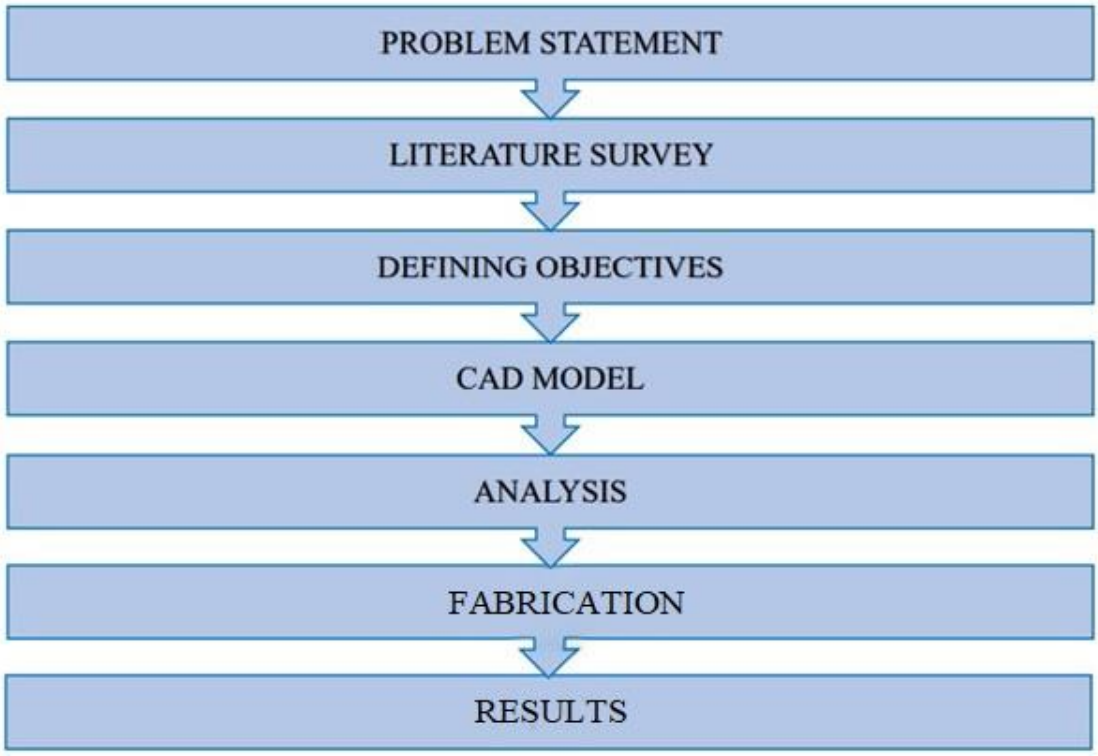
After the formation of crystals at room temperature. The crystals will settle down due to their weight. The problem which will be encountered is as follows. As the crystals have settle down at the bottom of the shell, the blade must be continuously rotating for grinding the crystals for making them finer. Due to this the blades might bend at locations, where they are connected to shaft. There is also a tendency that the solution might leak from either side of the shell from where the shaft protrudes out.

In order to overcome this problem, the blades should be designed such that they do not fail under the loading conditions. The blades must also facilitate for proper mixing of crystals. The leakage which can occurs can also be avoided by designing a suitable shaft seal.

Objectives:

1. The objective of the project is to design the shell and blade of the crystallizer for even mixing of the crystals.
2. Designing the shell such that it should hold the 40Liters of liquid solution.
3. Designing the shell and blade such that they can withstand under the dynamic loading conditions and temperature in the range of 80^0 Celsius to 100^0 Celsius.
4. Increasing the efficiency of the crystallizer by mixing the solution homogenously, which will lead to proper formation of crystals.
5. Designing the crystallizer such that its cost must be economical.
6. The blades of the crystallizer should facilitate for easy removal of crystals after the crystallization process.

Methodology:



Conclusion:

1. Even formation of crystals at the end of the crystallization as the blades facilitate cutting down the crystals which are larger.
2. Easy removal of crystals from the crystallizer as the blades facilitate removal by pushing the crystals out of the shell.
3. The blades were subjected to steady-state load in the Ansys workbench, and the deformation and the stresses induced inside the blades were within the safety limit.

4. The shell was subjected to steady-state load in the Ansys workbench, and the deformation, and the stresses induced inside the blades within safety limits.
5. The double-helical blades can mix viscous fluid efficiently when compared to the blades which were used in industry.
6. The shell is supported by trusses at the bottom to make the shell more structurally stable.
7. There are negligible amount of vibrations created in the fabricated prototype.
8. There is no impact force of helical blades as the blades shear and push the solution.