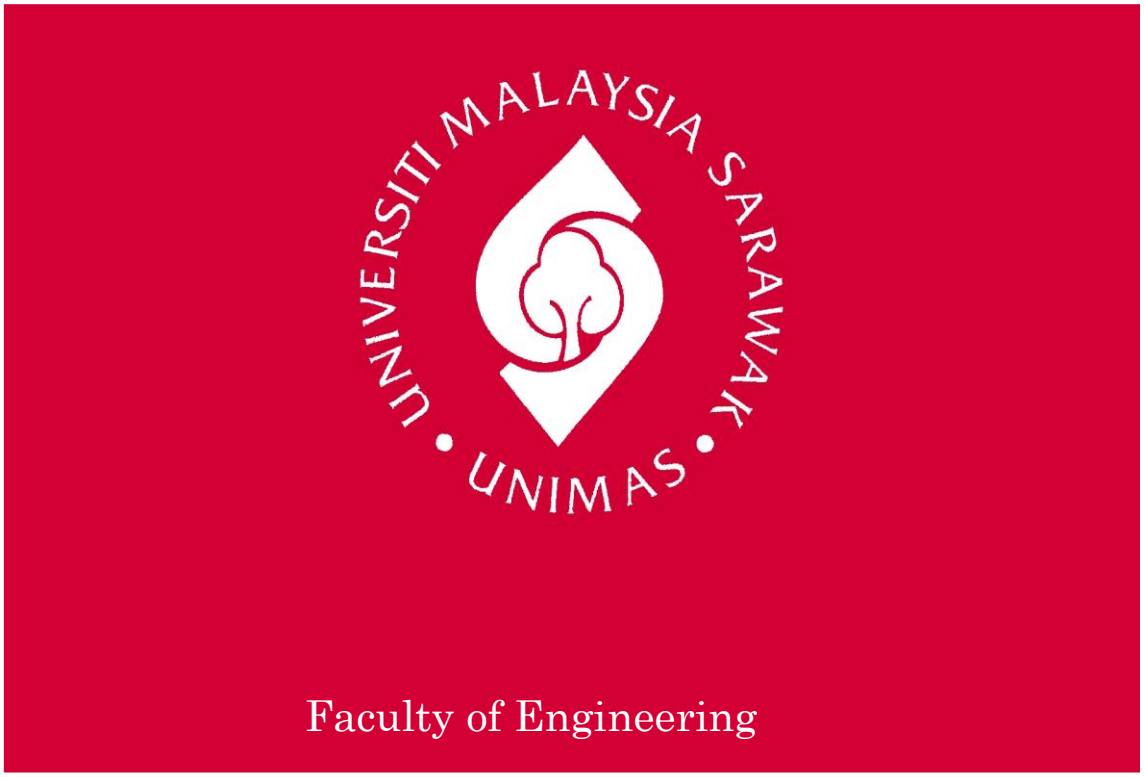

OPTIMIZATION OF SLUDGE FLOW BEHAVIOR IN A MIXING TANK THROUGH BLADE DESIGN

BONG KUEK KONG

Bachelor of Engineering with Honours

(Mechanical and Manufacturing Engineering)

2017

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (√)

Final Year Project Report	√
Masters	
PhD	

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This project report which entitled “Optimization of Sludge Flow Behavior in a Mixing Tank through Blade Design” was prepared by BONG KUEK KONG (40735) is hereby read and approved by:

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IR. DR. MOHD DANIAL BIN IBRAHIM Date

(Supervisor)

OPTIMIZATION OF SLUDGE FLOW BEHAVIOR IN A MIXING TANK THROUGH BLADE DESIGN

BONG KUEK KONG

A dissertation submitted in partial fulfilment

of the requirement for the degree of

Bachelor of Engineering with Honours

(Mechanical and Manufacturing Engineering)

Faculty of Engineering

Universiti Malaysia Sarawak

2017

Specially dedicated to my beloved family and friends

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ABSTRACT

Latic acids are very useful in industry for the food preservative and yet are expensive due to the high processing cost. One of the manners to get the latic acids is through the conversion from the starch. The starch need to under the liquefaction and saccrification in order to produce latic acid. Before the dual volume of reactor been introduced, the industries do the both processes in a separated tank. After the dual volume tank which is inner and out volume been introduced, both processes can be done simultaneously. By doing this, the heat from the inner tank can actually heat up the starch at the outer tank. However the problem occurs due to the high viscous of the starch, the current blade produces a very poor flow pattern. It will affect the mixing performance of the starch as well as affect the quality of the starch. Hence, the objective of this project is to study and modify the blade to improve the agitation in the reactor. The existing reactor is draw in the Engineering CAD software according to the original dimension provided by the owner. The existing blade and modified blade are designed and simulated by using CFD simulation. The result of the modified blade gives better flow distribution compare to existing blade.

ABSTRAK

Asid Latic sangat berguna dalam industri untuk pengawet makanan dan mahal kerana kos pemprosesan yang tinggi. Salah satu cara untuk mendapatkan asid latic adalah melalui penukaran daripada kanji. Kanji perlu melalui proses pencairan dan saccrificasi untuk menghasilkan asid latic. Sebelum dual isi padu tangki reaktor diperkenalkan, industri menjalankan proses pencairan dan saccrificasi di dalam dua tangki yang dipisahkan. Selepas dual isi padu tangki iaitu dalaman dan luaran isi padu telah diperkenalkan, kedua-dua proses boleh dilakukan secara serentak. Dengan cara ini, haba dari tangki dalaman boleh memanaskan kanji di tangki luar. Walau bagaimanapun masalah berkaitan dengan corak aliran berlaku disebabkan kelikatan kanji yang tinggi. Ia akan memberi kesan kepada prestasi pencampuran kanji dan juga menjejaskan kualiti kanji. Oleh itu, objektif projek ini adalah untuk mengkaji dan mengubah suai bilah untuk meningkatkan pergolakan dalam reaktor. Reaktor yang sedia ada telah direka dengan menggunakan kejuruteraan CAD mengikut dimensi asal yang disediakan oleh pemilik. Selepas itu, bilah yang sedia ada dan bilah diubahsuai direka dan simulasi dengan menggunakan simulasi CFD. Hasil bilah diubahsuai memberikan pengedaran aliran yang lebih baik berbanding dengan bilah yang sedia ada.

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μ	-	Viscosity
ρ	-	Density
ν	-	Velocity

LIST OF ABBREVIATIONS

CFD	-	Computational Fluid Dynamic
hr	-	Hour
m	-	Metre
mm	-	Millimetre
Re	-	Reynold’s Number
s	-	Second
3D	-	Three-dimensional

CHAPTER 1

INTRODUCTION

1.1 The Art of Mixing

Mixing operations are widely used in most of the industry that involving physical and chemical change. There are many other sectors carry out mixing operations on a large scale although much of the knowledge on mixing has developed from chemical industry. Thus mixing operation is a central feature of many processes in the food, pharmaceutical, paper, plastics, ceramics and rubber industries. In most cases, mixing is carried out usually to reduce inhomogeneities, especially in the mixing of particulate solids, or to enhance a rate process, particularly in mechanically agitated vessels. In order to achieve these requirements, an understanding of how the solids and liquids move is an essential prerequisite for a successful mixer design or selection. The different form of the move will have different mechanism of mixing. According to Harnby, Edwards and Nienow (1992), there are two types of mixing that is liquid mixing and solid mixing. In liquid mixing there are laminar and turbulent mixing. Laminar mixing is associated with high-viscosity liquids and turbulent mixing is used for the liquid that with low viscosity. Meanwhile solid mixing consist of three categories that is segregation. Segregation is carried out with two component system whose particles were identical in all important properties, differing perhaps only in colour.

1.2 Project Scope

Starch is a polymeric carbohydrate that consist of a large number of glucose unit. It can be found in most green plants such as maize (corn), rice, cassava and potatoes. Lattice acid can be obtained from the starch through liquefaction and saccharification. The liquefaction is where the water is mix with the starch involving the partial hydrolysis of starch, with concomitant loss in viscosity whereas the saccharification is the process of production of glucose and maltose. Although the raw material derived from biomasses are inexpensive, abundant and renewable but due to the complex cell wall structure of lignocellulose, it required a lot of cost to process it. In order to reduce the cost and energy lose, a new reactor with two inner and outer tank is introduce. This reactor consists of two motors with and followed by the gear reducers with gear ratio. The liquefaction will take place in the inner tank under 100 degrees Celsius for whereas the saccharification process takes place in the outer under 60 degrees Celsius.

Figure 1.1: The mixing tank

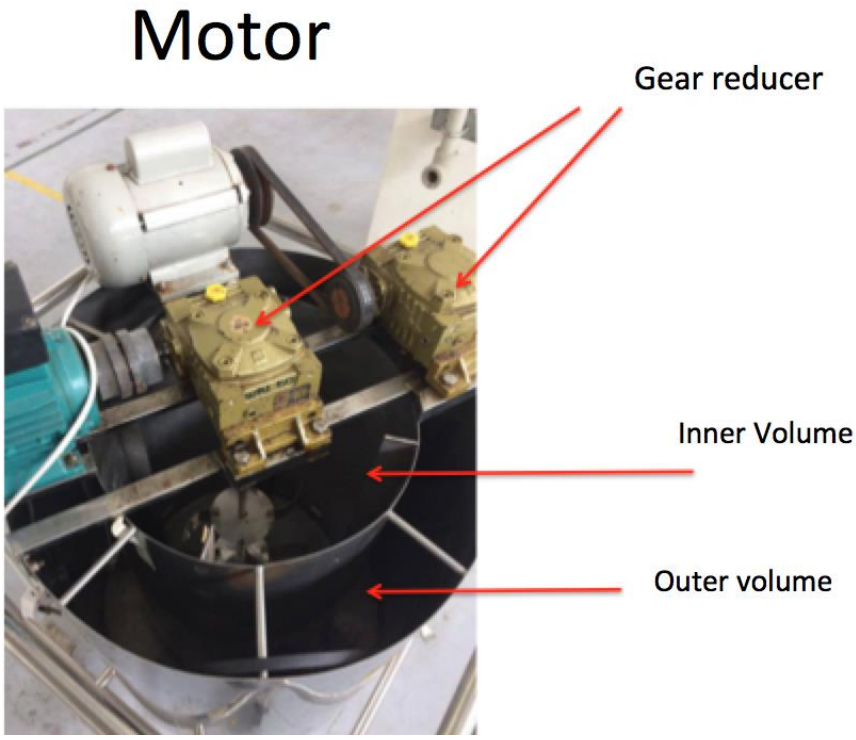

Figure 1.2: Top View of the Reactor

1.3 Problem statement

The main problem occurs when the materials like sago starch which are difficult to mix homogeneously. During the production of the sago starch products, the process of gelatinization if encountered before the production of dextrins. . Besides that, sago starch is a high viscosity solution. In order to mix it properly with the water, it required a high energy and proper design of mixing blade. Apart from that, the number of mixing blade inside the outer tank is consider less, this will cause the temperature and flow are not equally distributing to the solution. The flow of the mixing process inside the tank can be determined through CFD. Whereas the minor problem is time taken for the process is too long and causes the temperature to increase. The increase of temperature will melt the grease inside the gear resulting the grease to fall into the starch solution. The mixing will affect the quality of the starch due to the impurity particles.

1.4 Aims and Objectives

The aims and objective of this study are as below:

I. Study the agitation for the viscous fluid
II. Improved the surge flow of the inner tank
III. Improved the flow distribution in outer tank
IV. Minimized power consumption