



UNIVERSITI
TEKNOLOGI
MARA

Cawangan Terengganu
Kampus Bukit Besi

**TITLE: INTEGRATION OF BOW TIE ANALYSIS
AND ALOHA SOFTWARE FOR RISK AND
CONSEQUENCES EVALUATION FOR PHASE
SEPARATOR IN PRODUCTION OF METHANOL
ROUTE 1 DURING CHEMICAL PROCESS
DEVELOPMENT AND DESIGN**

**SUPERVISOR: MUHAMMAD FIRDAUS BIN
HUSIN**

**SCHOOL OF CHEMICAL ENGINEERING
COLLEGE OF ENGINEERING**

2023

ABSTRACT

Accidents in the chemical process industries are always dramatic and fatal. Equipment failure is frequently identified as the fundamental cause of many chemical mishaps, resulting in toxicity, fire, and explosions in the sector. The aim of this study is to conduct a hazard and safety evaluation of the chemical process industry, which can be discovered by employing a suitable risk mitigation plan for avoiding and minimizing the detected hazard and assessed risk through Bow Tie analysis and ALOHA modelling software. The Bow Tie analysis method and ALOHA modelling are employed as existing safety analysis procedures in this study, and they will be combined to improve the current safety assessments and their application. This combination is utilized because existing methodologies have difficulties in predicting the threat zone and inability to foresee the clear effects of the threat zone and is unable to predict visually. However, the ALOHA modelling software may determine the distance between the threat zone and the damage range of the hazard effects. ALOHA is required to assess the possibility of an accident occurring in that place. As a result, this study was conducted in order to improve and combine ALOHA software and BOWTIE analysis in order to generate more precise hazard and risk consequences. Both strategies can conceal their weaknesses, making the mitigation plan much easier to apply. A risk and consequences assessment should then be performed to clarify any potential disasters in the future. Mitigation plan is a succinct list of options for making the sector safer.

TABLE OF CONTENTS

	Page
AUTHOR'S DECLARATION	2
ABSTRACT	3
TABLE OF CONTENTS	4
CHAPTER ONE BACKGROUND	6
1.1 Introduction	6
1.2 Literature Review	8
1.2.1 Methanol	8
1.2.2 Hydrogen	8
1.2.3 Carbon Dioxide	9
1.2.4 Carbon Monoxide	9
1.2.5 Accidents related to the unit operation phase separator	10
1.2.6 BOWTIE Analysis	12
1.2.7 Areal Location Hazardous Atmosphere (ALOHA)	12
1.2.8 Inherent Safer Design (ISD)	13
1.3 Problem Statement	14
1.4 Objectives	15
1.5 Scope of Study	15
CHAPTER TWO METHODOLOGY	16
2.0 Introduction	16
2.1 Hazard Identification	17
2.2 Risk Assessment	18
2.3 Risk Analysis by BOWTIE Analysis	18
2.4 Consequences Analysis by ALOHA Modelling Software	19
2.5 Risk/Hazard Acceptance	24
CHAPTER THREE RESULT AND DISCUSSION	27
3.1 Introduction	27

3.2	Bow-tie Analysis result	28
3.3	ALOHA Software result	30
3.3.1	Direct Source	30
3.3.2	Puddle Source (Evaporating Puddle)	32
3.3.3	Puddle Source (Burning Puddle)	34
3.3.4	Tank Source (Leaking tank, chemical is not Burning)	35
3.3.5	Tank Source (Leaking tank, chemical is Burning as Jet Fire)	37
	CHAPTER FOUR CONCLUSION AND RECOMMENDATION	40
4.1	Conclusion	40
4.2	Recommendation	41
	REFERENCES	42

CHAPTER ONE

BACKGROUND

1.1 Introduction

The chemical process industry is one that processes raw (bulk) materials into completed goods or those that are useful to other industries through chemical transformation and plays a significant role in socio-economic development. Manufacturing facilities that produce goods from organic or inorganic materials, or from chemical reactions between the two, are included in the chemical processing sector. extraction with or without the use of chemical reactions, the separation or purification of natural products, and the preparation of mixes of components for a specific formulation, whether natural or synthetic. Chemical processing can also be used to create additional goods, such as rubber, ceramics, explosives, and spices, in addition to the ones already mentioned. Bear in mind that both employees and equipment must meet the high demands of the chemical processing sector. Most chemical processing plants manufacture their products using specialised machinery. This equipment can resist tough operational circumstances. However, the facility is subject to harsh conditions because of the nature of chemical processing. Workers are required to operate in these conditions; thus, they must be outfitted appropriately and possess the necessary skills and knowledge to carry out duties related to chemical processing without incident. What's more, all of the facility's equipment needs to be capable of withstanding high levels of pressure, heat, corrosion, and stress. From what has been stated above, it has been explain that the chemical process plant industry will always have the potential to face threats or face dangers whether caused by equipment or human error that can lead to a chemical accident. A chemical accident is defined as an incident that raises questions about the environment or public health as a result of the release of one or more harmful or potentially dangerous substances. The stages of emergency personnel's preparation for emergencies and chemical events are described by the chemical incident life cycle. It provides an overview of the techniques used to prepare for, prevent, respond to, and recover from such catastrophes. These give those working in medicine, emergency services, environmental containment, and other areas of chemical incident management a framework to lessen the risk of negative consequences