STUDY OF PIPE CONNECTOR EFFECT IN PIPING SYSTEM

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We certify that the project entitled "Study of pipe connector in piping system" is written by Muhamad Fikri Aziz Bin Mat Lah. We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering.

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

This thesis was carried out to investigate the effect of connecting pipes in a piping system using acoustic emission techniques. A plumbing system that is equipped with a number of connecting pipes was tested with acoustic emission sensors on the different fluid pressure. The sources of the acoustic emission signals (AE) is the activity prior to and after the fluid through connecting pipes and it is observed using acoustic sensors with a view of software USB E3.34.For study effects of pipe connections, all time domain parameters (maximum amplitude, power, RMS amplitude) of signals were observed and processed with the aid of Matlab software. All parameters were compared with the pressure of the fluid flow at eleven different points. The results showed that the difference between the AE parameters of high-flow pressure and low flow pressure is not much different. From this relationship, it may not conclude that the pipe connecting is the main factor to the difference in acoustic emission technique effects.

ABSTRAK

Tesis ini dijalankan bagi mengkaji kesan penyambung paip dalam suatu sistem perpaipan dengan menggunakan teknik pancaran akustik. Suatu sistem paip yang dilengkapi dengan beberapa bilangan penyambung paip diuji dengan pengesan pancaran akustik pada tekanan bendalir yang berlainan. Punca isyarat pancaran akustik (AE) adalah daripada aktiviti yang dihasilkan sebelum dan selepas bendalir melalui penyambung paip dan ianya dicerap menggunakan penderia akustik dengan paparan dari perisian AEWin bagi USB E3.34. Untuk kajian kesan penyambungan paip, semua nilai parameter domain masa (amplitud maksimum, tenaga, amplitud pmkd) dari isyarat dicerap dan diproses dengan bantuan perisian Matlab. Semua nilai parameter tersebut dibandingkan dengan tekanan aliran bendalir pada sebelas titik yang berbeza. Hasil menunjukkan nilai perbezaan parameter AE antara tekanan aliran tinggi dan tekanan aliran rendah tidak banyak berbeza. Dari hubungan ini, ia boleh disimpulkan bahawa penyambung paip tidak menjadi faktor utama kepada perbezaan kesan teknik pancaran akustik.

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LIST OF ABBREVIATIONS

AE   Acoustic emission

NDT   Nondestructive Testing

RMS   Root mean square

LAE   laboratory assistant engineer

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CHAPTER 1

CHAPTER 1: INTRODUCTION

1.1   INTRODUCTION

Transporting liquids through piping system is a common practice. The term piping system is not new and practically every person has used one. During the past decade, stainless steel pipeline has been used for major transportation of fluid system in many industries which is very important in daily life (Rocha, 1989). Without this proper technology, there will be a lot of problems faced by the administrators that can reduce the performance of the systems. For the general public there is very little understanding of the phenomena behind the use of piping system. Perfect piping will probably be forever elusive and pipe leaks will likely be always. The stainless steel pipes in water distributions and transmission systems are difficult to inspect for damage due to location below the surface of background. High pressure and high temperature operating condition causes stainless steel pipe leaking because of corrosion when it is operate for few years. In some application, like power plant, the failure of piping systems can cause several economic losses and in worst cases the lost of human lives (Makar et al., 2001).

The purpose of this thesis is to study about effect of piping connector in piping system. The research focused to determine the failure that occur in connector in piping system and analyze them by using Acoustic Emission (AE). This thesis will also respond to the following technical requirement:

i. To identify the characteristic of catastrophic (a sudden and total failure of some system from which recovery is impossible) failure event that will occur in piping system.

ii. Capability of AE sensor to detect failure surface defects (anomalies) since water is flow over the piping system.

1.2 PROJECT BACKGROUND

Piping systems are one of the most reliable and safest means of transfer of mater and energy. New material such as plastic products and composites has enhanced the domain of application of material systems in pipelines. Plastic pipes have salient features such as low weight, ease of connection and corrosion resistance [Mehdi Farshad, 2006]. The length of the piping system can achieve hundreds of kilometers and belong the piping system can occur mechanism failure modes including crazing, cracking, large deformation, buckling, fracture, local damage, corrosion and clogging of piping system. Piping system also has lot of connector to achieve at its destination.

The inherent dangers associated with installing and maintaining piping systems increase the importance of a mechanical engineer's role in designing for safety and accident prevention during project construction and throughout a facility's life cycle. There are three fundamental areas in which mechanical engineers can affect safety positively: system constructability, best practices for training construction and inspection, and system maintainability. Acoustic emission (AE) technique is one of the systems where the failure in piping system can be detected.

Although most injuries on job sites and in the workplace occur via material handling, the most significant risks in terms of potential impact on people and businesses are caused by fire and fume hazards. By specifying safer technology likes Acoustic emission technique and, the impact can minimize and eliminate the potential for certain accident and injuries.

1.3   PROBLEM STATEMENT

With the demands for increasing the times of using for piping system while identifying routes for decreasing manufacturing costs and times, more emphasis is put on developing methods for detecting the failure mode to prevent any injuries at the workplace. These are challenging tasks due to the following main reasons:

i.   Expensiveness of the components and material used for connector of pipeline that suggests the use of more conservative machining or material approaches to avoid scraps and/or additional machining.

ii.   Difficulty to experimental relationships between sensory signals and connector of pipeline caused by the complexity of machine based on size and handling.

iii. Geometrical complexity of the connector of pipeline that require complex tool paths in conjunction with a variety of machining techniques.

1.4   THE OBJECTIVE OF THE PROJECT

The objective of the project is to:

i.   Investigate the effect of pipe connector existence to the AE activity in piping system.

ii.   Classify the AE parameter that represents the AE events in the piping system.

iii. Justify and see the difference of the AE parameter between piping with and without connector.

1.5   SCOPE OF STUDIES

On focus of this project according to the following aspect:

i.   Perform the entire experimental apparatus such as laptop, a set of piping system, AE analyzer and other.

ii.   Investigates the signal produced by different number of connector.

iii.   The material of the piping system is galvanized pipe.

1.6   OVERVIEWS OF THE THESIS

This report is divided into five chapters. Chapter one gives the brief the content and background of the project. The problem statement, objectives and scope of study are also discussed in this chapter.

In chapter two, the literature review of the study is discussed. This chapter provided with basic component of piping system. Starting from the galvanized pipe and process to constitute its quality, then, I will go deeper into type of connector of the piping system. The second part of this literature will review about advantages and disadvantages of galvanized pipe fittings, Flow in piping systems. For my thesis, I also will be exposed about acoustic emission (AE) technology, principle of acoustic emission testing and AE phenomenon, type of AE signal, wave form characteristic and other most common NDT methods.

For chapter three, methodology of the experiment is reviewed. Flow chart and Gantt chart will be shown so that the time required for this thesis is on schedule. After that The Acoustic Emission (AE) technique and experimental setup are studied. Then, we will be explained about the how operation that we will use in this experiment. Finally, the experiment will be run with supervised by laboratory assistant engineer (LAE). Their supervision is important due to avoid unnecessary things happen.

In chapter four, the result from the experiment and characteristics of signal are shown for further analysis. In this chapter, the details of detail discussion to be determine. Follow by graph analysis to determine energy, root mean square (RMS) value, crest factor and maximum amplitude. The analysis also performed into suggestion about the catastrophic failure and the modifications are to be justified if needed. Results of further analysis performed are to be discussed and the best alternative design of the pipeline is to be justified.

Lastly in chapter five, the recommendation and conclusion are to be made. The next page shows the summary of the outline of this study.

CHAPTER 2

LITERATURE REVIEW

2.1   INTRODUCTION

The purpose of this chapter is to provide a review of past research efforts related to basic component of piping system, galvanized pipe and process to constitute its quality, type of connector of the piping system, Flow in piping systems, Acoustic emission technology, principle of acoustic emission testing and AE phenomenon and wave form characteristic produce from acoustic analyzer . A review of other relevant research studies also provided. The review is organized chronologically to offer insight to how past research efforts have laid the groundwork for subsequent studies, including the present research effort. The review is detailed so that the present research effort can be properly tailored to add to the present body of literature as well as to justly the scope and direction of the present research effort.

2.2   BASIC COMPONENT OF PIPING SYSTEM

A system can be described as a collection of related and/or interacting elements. The elements of a system may themselves consist of systems and may constitute their own subsystem, sub-subsystem and so on. A subsystem is a element or a functional component of a larger system and; it fulfills the requirement of a systemic entity which has been integrated into the large system and, as a constituting part, plays a role in the existence and behavior of the large system [Mehdi Farshad, 2006].From the systems point of view, pipeline like any other technical installation are not only assemble of elements, but are structural systems interacting with their environment.

For instance, the partial settlement of the soil around the buried pipe will change the pressure applied to the pipe and the stiffness of the pipe in relation with the stiffness of soil will determine the distribution of the soil pressure [Mehdi Farshad, 2006]. Figure 2.1 presents a sample of piping system.

Figure 2.1: Example of piping system

2.2.1 Galvanized pipe and process to constitute its quality.

Galvanized tube steel is an alloy of iron and carbon that has been rolled into a tube shape and then coated with zinc. Steel tubing is generally galvanized in one of two ways. It can be hot dipped, or passed through molten zinc, which forms a thick protective coating, or electroplated or passed through a solution of zinc with electrical current, which results in a thinner layer of zinc adhering to the steel. Figure 2.2 presents the sample of galvanized pipe.

Figure 2.2: Sample of galvanized pipe

Sources: http://www.made-in-china.com/showroom/hiyard/product-detailFoqEmvSJsxUA/China-Galvanized-Steel-Pipe-Nipples.html

When steel tubing is galvanized, the zinc that is adhered to it will corrode faster than the steel. This is beneficial because it acts to slow down the time that steel will take to rust. This process is actually electrochemical in nature, with zinc having a greater electronegativity than steel. When zinc is applied to steel with the knowledge that it will corrode faster, yet reduce its corrosion time, the zinc is referred to as a sacrificial anode.

Hot dipped galvanized tube steel is typically the product of choice for outdoor structural applications. This kind of tubing is often utilized in the construction of carports, playground equipment, farm buildings, awnings, canopies, and trailers. It can be coated with a baked enamel finish to give additional protection from corrosion. Figure 2.3 presents the process of hot dipped galvanized.

Figure 2.3: Hot dipped galvanized

Sources: http://www.idodsystems.com/galprocess.html

There are a lot of advantages of using galvanized tube steel in construction. It is very strong, less of it is needed to frame a building than if the same building were framed with wood. It also generally weighs less than wood. This usually means that a building will not have to be engineered for as much load, or weight, which often cuts down construction expenses. Other benefits of metal tubing include its rot resistance, fire resistance, and the fact that it will not split or warp.

2.3.1 Type of connector of the piping system

There are several types of connector in piping system. The purposes of connector are connecting pipes of different materials or different type of pipes that require different joining methods. Below are several sample connector of piping system.