ANALYSIS ON PASSING CHARACTERISTICS OF GAS VALVE USING AE

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ANALYSIS ON PASSING CHARACTERISTICS OF GAS VALVE USING AE

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A report submitted

in fulfillment of the requirements for the degree of

Bachelor of Mechanical Engineering (Maintenance)

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

JUNE 2021

DECLARATION

I declare that this project report entitled "Analysis on Passing Characteristics of Gas Valve Using AE" is the result of my own work except as cited in the references

Signature : .....

Name :Marrisa Binti Azman

Date : 27/7/2021

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Maintenance).

Signature : .....

Supervisor's Name : DR. NOR SALIM BIN MUHAMMAD

Date : .....

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DEDICATION

To my beloved family, for giving me inspiration and support that I need. To my friends, for their assistance and guidance.

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ABSTRACT

Valve passage research covers the inspection of internal valve leaks, such as the detection of internal leaking from a closed valve utilizing meaning signals. Crack research involves fatigue fracture propagation in steels and crack categorization in concrete structures. Corrosion activities in structures, such as the identification of corrosion sources, categorization of corrosion sources in a noisy environment, and early detection of corrosion in structures, are also included in these studies for corrosion research. Passing characteristics of a gas valve is studied by using LabVIEW simulation software. The AMSY-6 system, a completely digital multi-channel AE-measurement system from Vallen, was utilized in the research to listen to the produced AE signal in the valve. It has an 18 bit data acquisition card for precise results. This equipment was set up with a sampling rate of 5 MHz and a band pass filter with a frequency range of 95 kHz to 300 kHz. Seven of the 38 channels were utilized to extract AE data, which included RMS and peak amplitude, in order to detect the leaking signal. The research was carried out on a gate valve that was installed on a 4 inch pipe that controlled the flow of inert gases such as nitrogen, carbon dioxide, or argon. The research results show that an acoustic emission approach was used to detect internal leakage in a gas valve. For both open and closed valve states, RMS and peak amplitude characteristics were measured. The results show that the RMS parameter is sensitive in monitoring leakage signals in a gas valve, and that statistical analysis on peak amplitude data can enhance the identification of an internal leak.

ABSTRAK

Penyelidikan laluan injap meliputi pemeriksaan kebocoran injap dalaman, seperti pengesanan kebocoran dalaman dari injap tertutup menggunakan isyarat makna. Penyelidikan retak melibatkan penyebaran patah tulang pada keluli dan pengkategorian retak pada struktur konkrit. Kegiatan kakisan dalam struktur, seperti pengenalpastian sumber kakisan, pengkategorian sumber kakisan di persekitaran yang bising, dan pengesanan awal kakisan pada struktur, juga termasuk dalam kajian ini untuk penyelidikan kakisan. Ciri kelepasan injap gas dikaji dengan menggunakan perisian simulasi LabVIEW. Sistem AMSY-6, sistem pengukuran AE multi-saluran digital sepenuhnya dari Vallen, digunakan dalam penyelidikan untuk mendengarkan isyarat AE yang dihasilkan di injap. Ia mempunyai kad pemerolehan data 18 bit untuk hasil yang tepat. Peralatan ini dipasang dengan kecepatan pengambilan sampel 5 MHz dan penapis lulus jalur dengan julat frekuensi 95 kHz hingga 300 kHz. Tujuh dari 38 saluran digunakan untuk mengekstrak data AE, termasuk RMS dan amplitud puncak, untuk mengesan isyarat bocor. Penyelidikan dilakukan pada injap pintu yang dipasang pada paip 4 inci yang mengawal aliran gas lengai seperti nitrogen, karbon dioksida, atau argon. Hasil penyelidikan menunjukkan bahawa pendekatan pelepasan akustik digunakan untuk mengesan kebocoran dalaman pada injap gas. Untuk kedua-dua keadaan injap terbuka dan tertutup, ciri-ciri amplitud RMS dan puncak diukur. Hasilnya menunjukkan bahawa parameter RMS sensitif dalam memantau kebocoran isyarat pada injap gas, dan bahawa analisis statistik pada data amplitud puncak dapat meningkatkan identifikasi kebocoran dalaman.

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ACKNOWLEDGEMENT

Above all, praise to Allah S.W.T to whom we ask for help and forgiveness, the guidance and strengths in completing this report.

Next, I would like to sincerely appreciate my FYP supervisor, Dr Nor Salim Bin Muhammad for the help, guidance and useful advices which have contributed in many ways so that I could complete my report. Also not to forget, Faculty of Mechanical Engineering, UTeM for giving me the opportunity and providing facilities which I needed along completing the report.

Last but not least, deepest appreciation goes to my family, which never stop supporting me, for their never ending love and encouragement especially to my parents; Mr Azman Bin Hussin and Mrs Norlizatulakma Binti Othman. Your generosity means a lot and to those who have indirectly contributed to this research, thank you very much.

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LIST OF ABBREVIATIONS

AE	Acoustic Emission
EMI	Electro Magnetic Interference
LTC	Line Tap Changer
PD	Partial Discharge
PSD	Power Spectral Density
RC	Reinforced Concrete
RMS	Root Mean Square
TOA	Time of Arrival
NDT	Non-Destructive Testing

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CHAPTER 1

INTRODUCTION

1.1 Background study

Valve leakage in manufacturing environments is a frequent occurrence. Containers, vessels, enclosures, or other liquid structures are often examined for leaks to see whether there is any leakage and to find where the leaks are so that corrective measures can be taken. In certain situations, valves that leak internally can lead to substantial losses of valuable product or accidental transfer of process components, seriously raising process risks. When the valves malfunction, major problems will occur, such as resource waste, extreme failure, air emissions, enormous maintenance costs and life risks (Meland et al., 2011). Before the maintenance, leakages will occur, which could cost a huge loss due to contamination and lowering the instrument and device performance (Kaewwaewnoi et al., 2005).

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To ensure that the functionality of vital valves is satisfactory, stringent time-consuming leakage tests must be carried out. It is recommended that valves be tested at intervals of no more than 12 months in certain situations. However, depending on the valve state, the service condition, and the desired level of output, the exact interval can differ. There are several methods that have been introduced in the industries to test the leakage rate of the valve such as acoustic emission (AE), gas detection test and pneumatic test (Thompson & Zolkiewski, 1997).

Acoustic emission (AE) is used to recognize the leakage in the valve. Acoustic emission (AE) is a term that describes a class of phenomena in which transient elastic waves are produced within a material through the rapid release of energy from localised sources. (JR Matthewas. 1983). Acoustic emission technology is one of the powerful means of leakage detection, with the benefit of non-destructive online detection, comfort and high

precision, it has good applicability in principle for the issue of internal valve trace leakage (Xu et al., 2016). With that being said, it is the most suitable methods for valves leakage detection. On the other hand, as it is less susceptible to machinery noises and more sensitive to fluid flows and material deformations at the microscopic level, the AE technique is believed to provide earlier detection of valve problems compared to vibration (Sim et al., 2020). The phenomenon of AE is the radiation of sound and ultrasonic (stress) waves in materials subjected to stress during deformation and fracture processes. Acoustic Emission NDT is based on the detection, localization, and analysis of acoustic emission waves generated in stressed structures (Muravin, 2012).

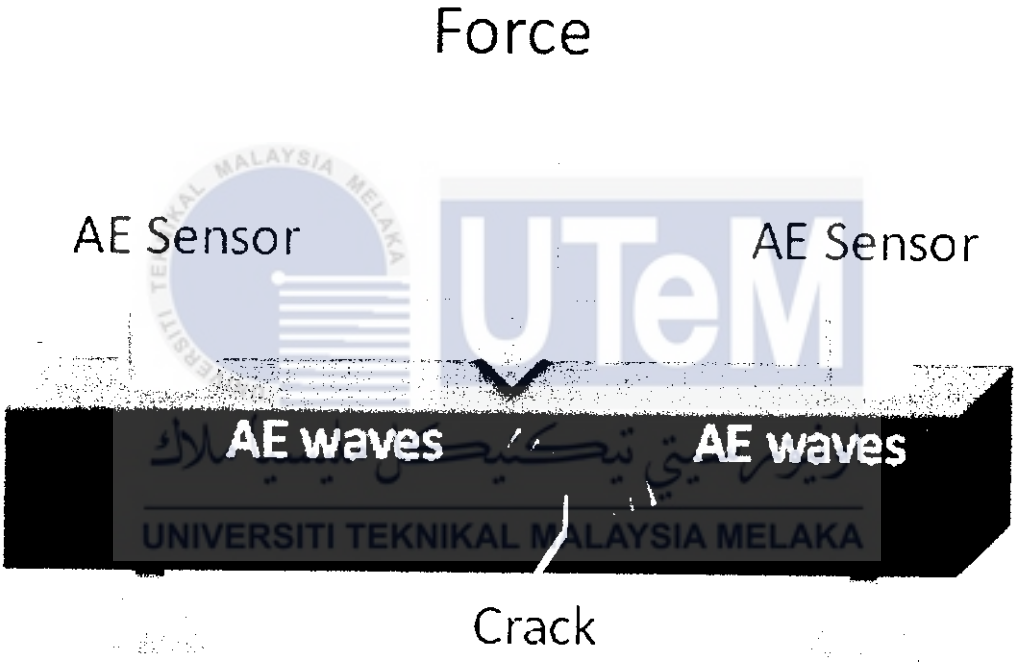

Figure 1.1 Acoustic emission waves generated due to crack development under stress in a solid material ((Muravin, 2012)

These are the following types of valves represent the most widely seen valves worldwide for industrial applications which are Gate Valves, Butterfly Valves, Ball Valves and Globe Valves. The valves comes in different models for each of these types and each of the valves has its own various features and functional capabilities. For stem material in butterfly valves, and trim components such as seat back seat bushings, discs, wedges, etc in

cast steel doors, globe and control valves, are the most common applications in valves used in industries.

Leakages might happened even it is not noticeable and does not produce any sound. Few of the typical causes of the leakage of valves are driven by several factors which are the valve is damaged. It is damage to either the seat or the seal which can cause leakage. Other than that, the size of the valve is not suitable with the valve thus it can cause leakage. Next, to determine the leakage or passing condition in a valve, few parameter need to be measured. For instance, amplitude, frequency and energy (Stone and Dingwall, 1997). These parameters will identify the condition of the valve passing by using acoustic emission (AE) equipment.

Acoustic emission (AE) method is frequently used in industry rather than other method is because acoustic emission gives a large number of advantages compared to other method such as vibration analysis. One of the benefits is the ability in their early stages to identify a number of harm mechanisms, including but not limited to, fibre breakages, friction, impacts, cracking, delamination and corrosion, before they become serious problems (Al-ghamd & Mba, 2006).

1.2 Problem Statement

Valves are used in many industries and need to be inspected regularly to prevent unexpected shutdown due to valve leakage in operation. The shutdown of the process operation and replacement of the valve or dismantling of the valve for inspection purposes will cause loss to the production line. Therefore, a method of valve passing detection in operation is required to reduce the cost in inspection as well as the loss due to the shutdown of the process operation for inspection purposes.

1.3 Objectives

The objectives of this projects are as follows:

1. To identify the AE parameter that can be used for detection of the valve passing.
2. To indicate the severity level of the passing valve.

1.4 Scope of Project

The scopes of this projects are:

1. Involve experimental using AE equipment for inspecting the passing condition of the valve.
2. Design suitable valve inspection method using AE.
3. Measure the parameters that can be used for analysis which can indicate the characteristics of the passing valve.
4. Find the best plot parameter indicating the passing valve.

1.5 General Methodology

The actions that need to be carried out to achieve the objectives in this project are listed below:

1. Literature review

   Articles, online journals, various types of online journal or any material regarding Acoustic emission (AE) will be reviewed and used in this project. The information is then rephrased and cited.

2. Simulation

   Perform value inspection by using AE signals using LabVIEW.

3. Record the value of AE parameter using LabVIEW.
4. Identify the parameter and analyse the changes parameters using LabVIEW.
5. Report writing

   A report on this study will be written at the end of the project.

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CHAPTER 2

LITERATURE REVIEW

2.1 Type of Valves in Industry

Valve is an important device for the automatic control system and protection system for petrochemical processing, known as throat in the petrochemical industry (Zhu et al., 2014). There are a range of models for each of these types, each with various features and functional capabilities. Popular types of natural gas field station valve leakage primarily include valve packing leakage, valve body and coating leakage, sealing cover leakage, sealing ring leakage, closing component leakage and flange link leakage (Xiping et.al 2005). Owing to the unfair distribution of equipment, the bad working environment and non-standard operation, valve internal leakage has become a common phenomenon in the petroleum and chemical industry. It dramatically increased the risk of the petroleum and chemical industry in the efficient process and placed a major burden on the detection of faults and earlier safety alerts in the entire process system.

There are numerous types of gas valve that are usually used in the industries for instance gate valve, globe valve, piston valve, butterfly valve and ball valve. A gate valve is a valve that opens by raising a barrier (gate) out of the fluid pathway, also known as a sluice valve. In the petrochemical industry, gate valves are typical equipment. The body parts, disc, cover, stem, bench, yoke and so on are included in the gate valve. The usual structure of the gate valve, where (a) sealing face/disc, (b) valve stem, (c) internal structure is shown in Fig 2.1.

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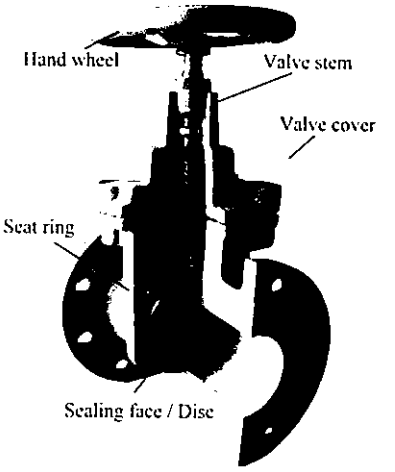

Fig. 2.1 Typical Gate Valve: (a) Face/Disc Sealing, (b) Stem of the Valve, (c) Internal Structure (Zhu et al., 2015)

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It is guided by the disc and, along with the sealing face, induces linear lifting motion. The disc movement direction is vertical to the gas medium flow direction in the channel in the process of opening or closing the doors. Because of efficiency, service, corrosion and other factors, it also causes internal leakage and has adverse effects on safety production, environmental protection and energy conservation (Zhu et al., 2014).

Globe valves are still frequently used, but as a result of developments in rotary valve and actuator designs, their dominance in throttling control applications has been reduced by the less costly rotary (ball, butterfly, and plug) valves. Globe valves in household applications are widely used. The globe valve is commonly used in various industries as a common pipeline feature, and its fluid control output typically determines the stability and energy consumption of the whole system. In fact, in the entire piping system, the driving energy of the globe valves, which is used to open and close the valve, accounts for a high

percentage (Qian et al., 2018). These are used for water faucets and plumbing for other households. For applications asking for regular opening and closing, these are preferred. Global valves typically use a linear-motion stem connected to a plug head that regulates the flow area through a stationary seat ring. The key advantages of the conventional world model include the simplicity of the design of the pneumatic actuator, the availability of a broad range of valve features, the relatively low possibility of cavitation and noise, and the availability of a wide range of advanced designs for corrosive, abrasive, and high-temperature or high-pressure applications (Besla G. Liptak, 2006).

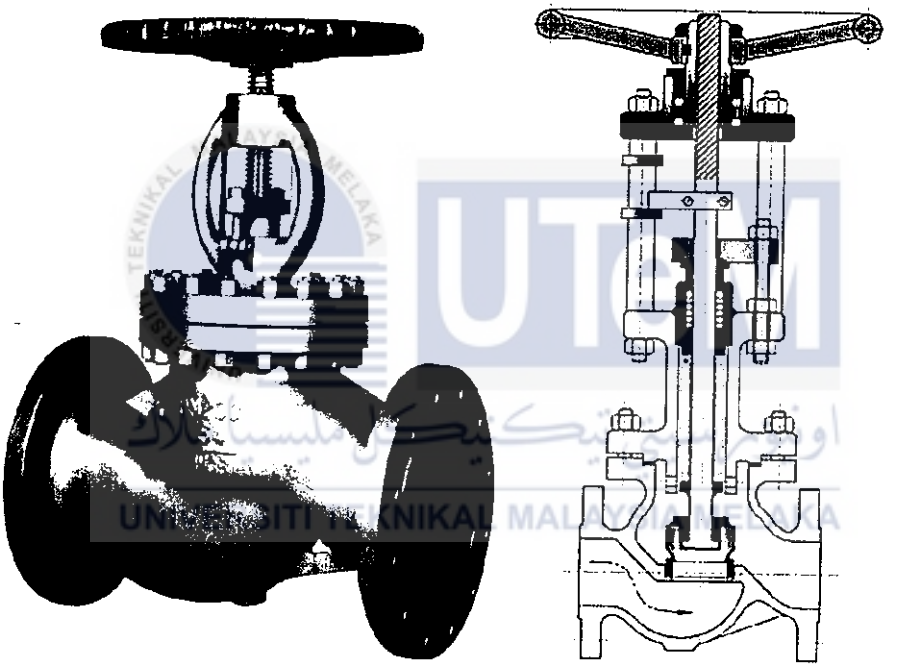

Fig 2.2 Globe Valve (Globe Valve Types and Parts - A Complete Guide, 2020)

Next is piston valve. A piston valve is a system used inside a chamber or cylinder to control the motion of a fluid along a tube or pipe by means of the linear motion of a piston. The seat seal is formed between the side faces of the piston and the seat bore. When the valve is opened, the flow cannot commence before the piston has been entirely separated from the seat bore. Therefore, any erosive disruption happens away from the seating surfaces. Like globe valves, piston valves allow good flow control. If sensitive flow adjustment is needed, the piston can be fitted with a needle-shaped extension. Piston valves