

# MODIFICATION OF HAND HOLE VALVE IN 10 KG CAPACITY MINI GASIFIER MACHINE

**Fachri Koeshardono<sup>1</sup>, Aris Suryadi<sup>2</sup>, Mukhlis Hunafa<sup>3</sup>, Aep Baihaki<sup>4</sup>**

<sup>1,2,3</sup> Manufacturing Process, Mechanical Engineering Department, Politeknik Negeri Bandung, Jalan Gegerkalong Hilir Desa Ciwaruga Kabupaten Bandung Barat Indonesia.

<sup>4</sup>PT Mitsuba Automotive Parts Indonesia Kawasan Industri Kota Bukit Indah, Blok D-III No.3, Purwakarta 41181 Jawa Barat, Indonesia

<sup>1</sup>Email: [fachri.koeshardono@polban.ac.id](mailto:fachri.koeshardono@polban.ac.id)

<sup>2</sup>Email: [hunafamukhlis@gmail.com](mailto:hunafamukhlis@gmail.com)

<sup>3</sup>Email: [aris\\_aers@polban.ac.id](mailto:aris_aers@polban.ac.id)

<sup>4</sup>Email: [aepbaihaki07@gmail.com](mailto:aepbaihaki07@gmail.com)

## Abstract

Coal is one of the fossil fuels generally is that sedimentary rocks can ignite, formed from organic deposits. Along with the depletion of reserves of fossil energy sources, there is a coal energy conversion technology that is the gasification process. Gasification is a thermos-chemical conversion process from solid material to gas fuel that can be used for various needs. Tools for the gasification process are called gasifiers, one type of which is a fixed bed gasifier. A fixed bed gasifier is a gasification system using a number of solid fuels (coal / biomass) through which air and gas can pass either up or down. This type is the simplest type used on a small scale, this gasifier tool is usually small and often called a mini gasifier. Generally, there are major gasifier mini parts namely; hopper, reactor, water storage, steam drum, cyclone separator, splitter, and blower. Mini gasifier has a problem in the hand hole valve which is in the reactor section where the hand hole valve is difficult to open and close or impractical because it uses as many as eight bolts so that the alignment of the bolt so that the bias is closed tightly, it is necessary to improvise a new design on the hand hole valve deal with the problem. Two alternative designs were made to determine the right solution, design A in the form of an acetyline gas valve and design B in the form of a modification of the valve that was pre-installed on the reactor. Hand hole B valve design was chosen as a solution to handle this problem.

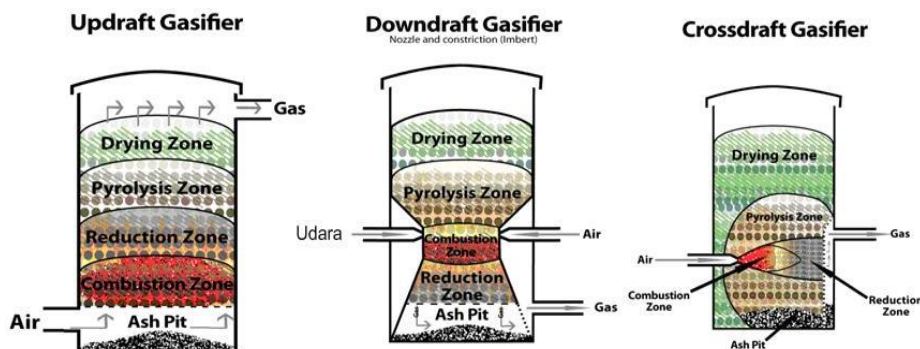
**Keywords:** Coal Gasification, Mini Gasifier, Hand Hole Valve.

## Introduction

Coal is one of the fossil fuels. The general understanding is that sedimentary rocks can ignite, formed from organic deposits. Coal has a main element consisting of carbon, hydrogen and oxygen. The formation of coal requires certain conditions and occurred in certain eras. It is estimated that 340 million years ago was the formation of coal on earth [1]. Coal has various clasifications, the classification of coal based on the level of fossil plants has turned into carbon and it is indicated how long the coal lived, he older coal generally has a high carbon content.

Coal classification based on the lowest quality is, lignite, sub-bituminuous, bituminuous and anthracite. Lignite coal is the lowest type of coal with a moisture content up to 45%, sub-bituminuous coal has a moisture content of 20-30%, bituminuous coal has a moisture content of less than 20% and anthracite coal is the best coal has a moisture content of less than 15%. Indonesia merupakan salah satu penghasil batubara terbesar di dunia, batubara di Indonesia mayoritas berjenis lignite, sub-bituminuous dan bituminuous. Sedangkan jenis antrasit hanya sedikit jumlahnya [2]. Along with the depletion of fossil resource reserves and awareness of environmental sustainability, research and development of coal energy conversion technology has received attention again. Coal energy conversion technology, especially the gasification process is influenced by fears of scarcity and rising oil and gas prices [3]. Gasification is a thermo-chemical conversion process from solid material to gases that can be used in various applications. Solid material such as coal, biomass, charcoal and the gases produced such as, CO, CO<sub>2</sub>, H<sub>2</sub>, H<sub>2</sub>O and CH<sub>4</sub>. Simply stated, gasification can be explained as a gradual combustion process, carried out with limited availability of oxygen, so that the gas formed from combustion still has the potential to ignite. The gasification process consists of four separate stages: Drying, pyrolysis, oxidation / combustion and reduction [4,5,6,7]. These four stages occur naturally in the combustion process, in gasification these four stages are passed separately, so as to interrupt the "fire" and maintain the flammable gas in the form of gas and flow the gas product to another place. Coal gasification is a thermochemical / partial / total oxidation process of coal into a combustible synthetic gas with high calorific value, so that it can be directly used as fuel [8]. Gasification has the advantage of low environmental impact, high effective conversion and reduced global CO<sub>2</sub> emissions [9]. The making of gas from coal has been carried out since the 17th century, but was only applied mainly to flight lights in England and France in the late 18th century [10].

Gasifier is a gasification technology that is used to convert coal into gas fuel that is processed in the reactor. there are 3 types of fixed bed gasifier, namely updraft gasifier, downdraft gasifier, and crossdraft gasifier [4,11,12].



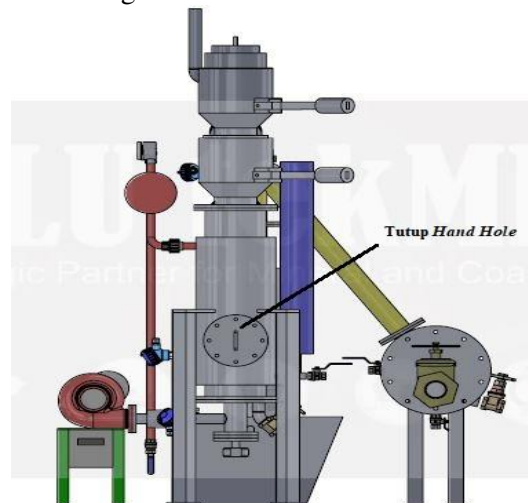
**Figure 1.** Types of Fixed Bed Gasifier

This type is the simplest type used on a small scale, this gasifier machine is usually small and often called a mini gasifier. Indonesia has a mini coal gasifier machine with Updraft Gasifier type developed by Teknologi Mineral dan Batubara (TEKMIRA) institute. This Machine can be used for heating or combustion, so a mini coal gasifier can be a choice of other fuels such as

LPG, wood, solar. Mini gasifier has main parts, namely: hopper, reactor, water storage, steam drum, cyclone separator, splitter, and blower [11].

Hand Hole Valve is one part of the reactor that functions to enter the coal that has been burned to see whether the coal is burning well or not. The Hand Hole Valve has its own problems. The problem is:

1. Hand hole valves are difficult to open and close or impractical because they use as many as 8 bolts so that the alignment of the bolt must be tightly closed.
2. Gas leak occurs if the bolt is not installed correctly.
3. Need a long time when installing it so much time is wasted.



**Figure 2.** Position of the Hand Hole Valve on Mini Gasifier



**Figure 3.** Hand Hole Valve Before Modification

### **Methods and Importance of The Research**

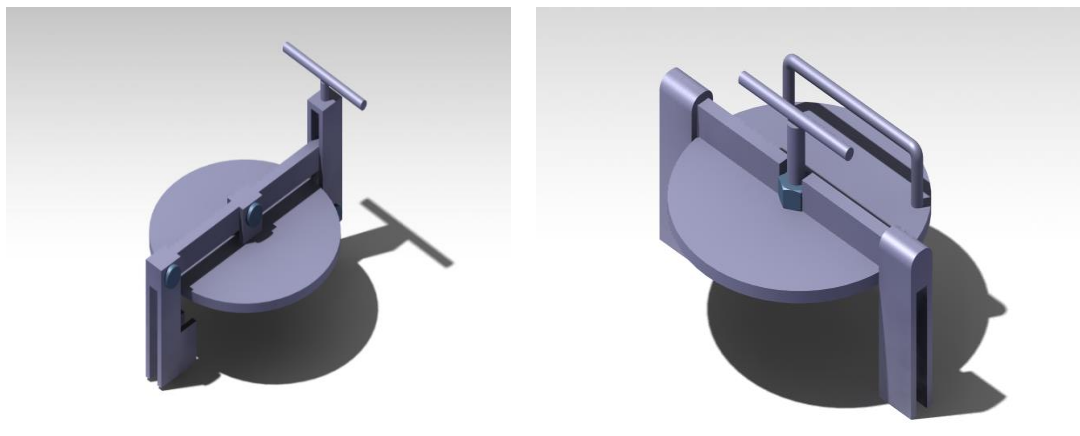
The team made modifications, namely the Hand Hole Valve will be modified in the form of an acetyline gas valve as shown below.



**Figure 4.** Valve on the acetylene gas

The reason why choosing to imitate the acetyline gas cover, is because the acetyline gas cover is more practical, easy to make and looks like a Hand Hole Valve, to add a new part to the design of the Hand Hole Valve, the Hand Hole Valve is given an additional section to attach the handle in a place that is is desirable.

The design process of the team created two design alternatives that aimed to choose from several aspects that were needed, and could have a comparison so that the design used was effective. Here are the design alternatives that the team made:



(a)

(b)

**Figure 5.** Design alternative A (a), Design alternative B (b)

Alternative designs that have been made both have advantages and disadvantages that become aspects of the assessment in determining the design to be used. Following is a table of strengths and strengths of each design.

Table 1. Strengths of each alternative design

No	Design Alternative A	Design Alternative B
1.	Easy to operate	Simply Design

2.	Simply Design	No need to add many components.
3.		Easier to make

Table 2. Weaknesses of each alternative design

No	Design Alternative A	Design Alternative B
1.	Must make from scratch	Less attractive design
2.	longer manufacturing time	

Looking at Table 1 and Table 2, shows that Alternative Design B has more advantages and fewer disadvantages. This design selection decision is inseparable from discussions with the supervisor and the technician making the tool because alternative design B is more effective and efficient in its manufacture. Then alternative design B is chosen.

**Results**



**Figure 6.** Hand hole valve after modification

The picture above is the result of making Hand Hole Valves after modification, due to the need to save costs, valves that have been perforated are not replaced with new ones. But to avoid gas leakage in the holes in the valve, the hole is already covered by seal packing inside the valve.

**Conclusion**

Modification of the hand hole valve refers to alternative design B is an effort to solve the problem on the mini gasifier so that it is easy to operate when the gasifier is used.

**References**

1. Dedy Sulisty, "Analisis Potensi Pembangkit Listrik Tenaga Gas Batubara di Kabupaten Sintang", Jurnal ELKHA, Vol. 4, No. 2, Oktober 2012.
2. Erlina Yustanti, "Pencampuran Batubara Coking Dengan Batubara Lignite Hasil Karbonisasi Sebagai Bahan Pembuatan Kokas", Jurnal Teknologi Pengelolaan Limbah, Vol. 15, Supplement Edition, 2012, ISSN 1410-9565.
3. Heri Susanto, "Pengembangan Teknologi Gasifikasi untuk Mendukung Kemandirian Energi dan Industri Kimia", Forum Guru Besar ITB, November 2018.
4. Wira Widyawidura *et al*, "Pengaruh Jenis Bahan Terhadap Proses Gasifikasi Sampah Organik Menggunakan Updraft Fixed Bed Reactor", Journal Engine, Vol. 1, No. 2, November 2017, ISSN 2579-7433.
5. S.Rajesh *et al*, "Biomass Gasification Development By Using Downdraft Gasifier", International Journal of Scientific and Engineering Research, Vol. 8, Issue 6, June 2017, ISSN 2229-5518.
6. L.C. Laurence and D. Ashenafi, "Syngas Treatment Unit for Small Scale Gasification – Application to IC Engine Gas Quality Requirement", Journal of Applied Fluid Mechanics, Vol. 5, No.1, March 2011, ISSN 1735-3572.
7. Wasu Sukswan *et al*. "Development of Mini Pilot Fluidized Bed Gasifier for Industrial Approach: Preliminary Study Based on Continuous Operation", Journal of Advanced Research in Fluid Mechanics and Thermal Sciences, Vol. 45, Issue 1, May 2018, ISSN 2289-7879.
8. I Putu Sutrisna dan Bambang Suwondo Rahardjo, "Rancangan Dasar Gasifier Batubara Sirkulasi Unggun Mengambang untuk Membangkitkan Listrik 1MW", Jurnal Sains dan Teknologi Indonesia, Vol. 9, No. 2, 2 Agustus 2007, ISSN 0853-9723.
9. R N Singh *et al*, "Experimental Investigation of Horizontal Gasifier", International Journal of Science, Technology and Society, Vol. 2, No. 1&2, January 2016.
10. Slamet Suprpto *et al*, "Pemanfaatan Gasifikasi Batubara untuk PLTD Sistem *Dual Fuel*", Jurnal Teknologi Mineral dan Batubara (Tekmira), Vol. 5, No. 3, Juli 2009.
11. Fajri Vidian, "Gasifikasi Tempurung Kelapa Menggunakan *Updraft Gasifier* pada Beberapa Variasi Laju Alir Udara Pembakaran", Jurnal Teknik Mesin, Vol. 10, No. 2, Oktober 2008.
12. Yenny Sofaeti, "Laporan Kegiatan Litbang 2012 Rancang Bangun Gasifier Mini", Pusat Penelitian dan Pengembangan Teknologi Mineral dan Batubara, 2012.