

DESIGN AND DEVELOPMENT OF USED AL-QURAN PAPER DISPOSAL SYSTEM

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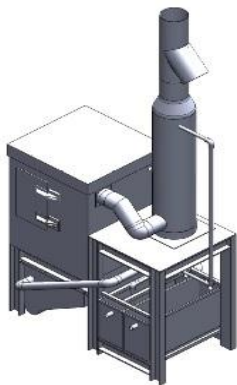
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Graphical abstract



Abstract

The idea of this project was to design and fabricate a combustion chamber of incinerator for Quran paper burning with a capacity of 10 kg/h, which is heated by Liquefied Petroleum Gas, LPG as fuel for the burner. This small capacity 10kg/h incinerator is portable type. The focus customers are Department of Islamic Development, Malaysia, JAKIM and other Islamic authority in Malaysia that can dispose the Quran used paper with their own facility without sending out to third parties. The customer can reduce space, cost and time because the storage and transport are not required. This incinerator is a retort type consist of primary and secondary chambers. The secondary chamber is further divided into mixing and combustion sections. The function of secondary chamber is to provide complete combustion to Quran paper burning process. The temperature for primary chamber is set of range from 200 to 218 degree Celsius. This design is fabricated based on standard stated by Environment Authority.

Keywords: Incinerator, Quran paper, paper, dispose.

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1.0 INTRODUCTION

Al-Quran is a collection of speeches (Kalam) of Allah that were revealed to Muhammad (S.A.W) by stages after he has been appointed as Rasul. Quran is the control text of Islam. As believed by Muslims the Quran is the holy book presented by Allah to mankind as references.

Because of its position as a holy book, used Quran paper should be disposed in a controlled manner. Due to that reason Department of Islamic Development Malaysia (JAKIM) has produced a guideline with two methods in disposing used Quran paper, which are either by incineration or burying [1]. In incineration method the burning process must be in a closed system, where all the ash produced during incineration process have to be buried or thrown in the open sea. The 30th Muzakarah of the Fatwa Committee, 1992 has stated that there are

only two methods on disposing torned or defective Quran verses, it is by burying and burning [1].

In disposing Quran through incineration, all the ashes produced must be collected for disposal process afterwards. The best method to burn Quran papers in control environment while following standard from authorities of Malaysia is by using closed combustion chamber or incinerator. In order for it to be called incinerator, the design should includes 3 chambers, namely ignition chamber, mixing chamber and combustion chamber [2]. The purpose of the incinerator is to turn all used Quran paper into ashes through complete combustion, meaning no papers are left unburn. The burning process will produce both flying and bottom ash. Bottom ash is easy to collect, while flying ash will fly out to the environment.

In order to collect the flying ash, scrubber is required to collect and separate the ash with the smoke. Water

scrubber uses spray tower concept which uses small water droplets as medium to trap any flying particulates along the chimney. Spray nozzle placed at the top of the chimney produces water droplets that give direct counter with the gas or smoke flow [3].

In order to improve the process of disposing used al-Quran paper, the objectives of this project are:

1. To design and fabricate an incinerator for burning paper with a capacity 10kg/hr
2. To test the product whether it meets the criteria for disposing al-Quran paper according to guideline

2.0 CONCEPT DESIGN

Figure 1 shows the elements involved in producing concept design of the incinerator for disposing used Quran paper.

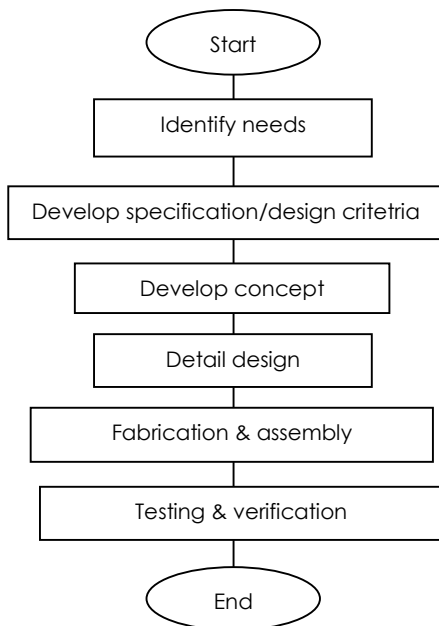


Figure 1 Flowchart of Process Involved in Concept Design

In developing the specifications or design criteria of the incinerator, the guidelines from the authority become major reference as it needs to be in compliance with it. One of it is that all ashes from the burning process should be collected and nothing is left to fly lose. When all the important criteria for the design has been notified, the concept for the design is then established. This includes the size, components, safety, maintainability, quality and aesthetics value of the incinerator. Functionality would be the major factor of consideration for the design. In detail design, the concept was modelled and designed using CATIA software for the purpose of visualization on how the product would look like. Figure 2 shows the detail

design of the incinerator which includes combustion chamber, water scrubber and ash collector.

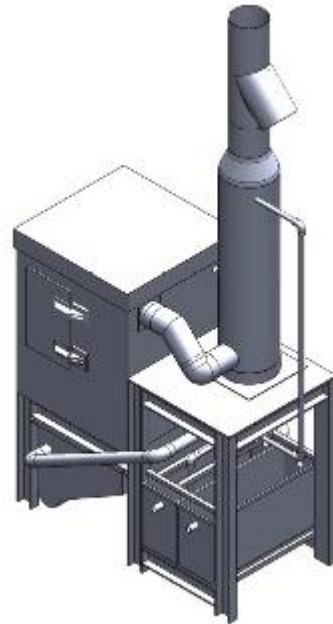


Figure 2 CAD Model of the Paper Disposal using CATIA Software

3.0 PROTOTYPE FABRICATION

From the incinerator design modelled using CATIA software, the dimensions of the design are used as guidelines for the fabrication of its prototype. Prototype fabrication is important for testing of functionality and efficiency purposes. The main process involved in the fabrication of the incinerator is casting. Figure 3, Figure 4 and Figure 5 shows the casting of combustion chamber using refractory concrete.



Figure 3 Mould For Primary and Secondary Chamber



Figure 4 Refractory Concrete Poured Into the Main Chamber



Figure 5 Combustion Chamber

The whole incinerator is the combination of closed combustion chamber, water scrubber and ash collector positioned at the bottom. Figure 6 shows the completed prototype fabrication of the used Quran paper disposal.



Figure 6 Complete Fabrication of Quran Paper Disposal

4.0 RESULT AND DISCUSSION

The result of performance test for this project is focused on batch waste charge testing during standard operating procedure. Based on the result, operators can ensure that every batch can pass through the paper charging door easily while at the same time know about the maximum batch size per paper charge. Figure 7 and 8 shows the testing process of the incinerator and the final product of it.

Batch incinerators are designed to accept wastes within a specified range of energy values. Paper have high energy value, and with the batch system, it has limited the loading capacity to small capacity specifically for burning Quran's paper. According to the test result, the maximum capacity that can only load per batch is 2 kg per batch wastes charges. More than that, the paper loaded will cover flame port area and block the flame burner.

Before papers are loaded into the incinerator in batch for disposal, it were shredded for easier burning process before being weighed based on batch.



Figure 7 Testing of the incinerator



Figure 8 Ash collected being released

Table 1 Result of 1 kg per batch paper

Waste and Burn Date	Weight of Waste	Burn Time	Primary Chamber	LPG Usage	Fuel Cost
	Kg(s)	Minute(s)	°C	Kg(s)	RM
December 30 th 2013 – Paper Waste					
Load 1 (start of burn)	1	5	225	–	–
Load 2 (10 minutes later)	1	5	313	–	–
Load 3 (25 minutes later)	1	5	252	–	–
Load 4 (35 minutes later)	1	5	267	–	–
Load 5 (50 minutes later)	1	5	308	–	–
Load 6 (55 minutes later)	1	5	387	–	–
Load 7 (80 minutes later)	1	5	480	–	–
Load 8 (95 minutes later)	1	5	514	–	–
Load 9 (110 minutes later)	1	5	574	–	–
Load 10 (125 minutes later)	1	5	625	–	–
–	–	10	–	–	–
Total	10	60	–	1	1.90

Table 2 Result of 2 kg per batch paper

Waste and Burn Date	Weight of Waste	Burn Time	Primary Chamber	LPG Usage	Fuel Cost
	Kg(s)	Minute(s)	°C	Kg(s)	RM
December 30 th 2013 – Paper Waste					
Load 1 (start of burn)	2	10	255	–	–
Load 2 (15 minutes later)	2	10	355	–	–
Load 3 (35 minutes later)	2	10	373	–	–
Load 4 (55 minutes later)	2	10	391	–	–
Load 5 (70 minutes later)	2	10	487	–	–
–	–	10	–	–	–
Total	10	60	–	1.1	2.09

From the tests conducted, it was found that burning 1 kg per batch paper charge took 125 minutes for complete combustion of 10 kg paper. On the other hand, burning 2 kg per batch paper charge took only 70 minutes for complete combustion of 10 kg paper. This can be referred to from results tabulated in both Table 1 and Table 2. Long operation will reduce the efficiency of the incinerator and cause discomfort to the operator. Thus, 2 kg per batch of waste charge is the best size to achieve optimum operation.

Throughout the tests conducted, no flying ashes were found to be escaped from the incinerator, which indicates that the water scrubber system works efficiently. This is also vital in order for the incinerator to be sharia compliant as the guideline stated that all the ashes produced must be collected for disposal process afterwards.

5.0 CONCLUSION

In conclusion, this project has achieved its objectives in which to design and fabricate an incinerator for

Quran burning paper with a capacity of 10kg/hr and also to test the fabricated product. Several tests were performed to identify optimal operating levels using various waste batch size. The maximum size for batch waste incinerators charge is 2 kg per batch, with operation of 70 minutes compared to 1 kg per batch which took 125 minutes. Long operation will reduce efficiency and cause discomfort to the operator. Thus, 2 kg per batch of waste charge is the best size to achieve optimum operation.

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