EFFECTIVE AIR EXTRACTION SYSTEM AND SAFE PROTECTION FOR WELDING BAY IN INSTITUTION OF HIGHER LEARNING

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EFFECTIVE AIR EXTRACTION SYSTEM AND SAFE PROTECTION FOR WELDING BAY IN INSTITUTION OF HIGHER LEARNING

SESI PENGAJIAN: 2008/2009

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ABSTRACT

In this paper, the objective of the study is to determine the effective air extraction system and safe protection during welding process for welding bay in institution of higher learning. This thesis begin with a visitation at institution which have air extraction system to study more detail about this system. Some interview with the coordinator is needed to get their experience during handle their laboratory. The next step is design and fabricate the portable air extraction system for the analysis process. Its start with sketching, 3D drawing and fabrication. For the analysis, some distance and angles was taken to get the effective distance and angle of that system during welding process. The sample of the welding also was taken to determine the good distance of hood of the system before its disturbing the structure of the workpiece. So that the student will know the effective distance and angle and safe protection for the welding.

ABSTRAK

Objektif dalam thesis ini adalah untuk mengkaji keberkesanan sistem penyedut udara dan alat-alat keselamatan yang sesuai digunakan ketika proses pembelajaran khususnya untuk peringkat yang lebih tinggi. Thesis ini bermula dengan melawat beberapa tempat pengajian tinggi dalam bidang kimpalan untuk melihat dan mengenali dengan lebih dekat lagi sistem penyedut udara ini. Pengalaman daripada pakar-pakar dalam bidang ini amat diperlukan. Proses berikutnya adalah mencipta sendiri alat penyedut udara ini yang mudah alik untuk mengkaji kedukukan yang paling berkesan sistem ini ketika proses pengimpalan. Ianya bermula dengan proses lakaran, rekabentuk dalam 3 dimensi, dan seterusnya membuat sistem tersebut. Untuk proses analisis pula, beberapa jarak dan sudut diambil kira untuk mengkaji tahap paling berkesan ketika proses kimpalan. Sampel kimpalan juga dibuat untuk mendapatkan jarak yang selamat muncung penyedut udara itu agar tidak menggangu kelancaran dan struktur kimpalan. Dengan ini pengguna kimpalan dapat mengetahui jarak dan sudut yang paling berkesan serta kelengkapan yang selamat semasa proses kimpalan.

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LIST OF ABBREVIATIONS

AES	Air Extraction System
CAD	Computer-aided Design
CAE	Computer-aided Engineering
cm	Centimetre
TIG	Gas Tungsten Arc Welding
SMAW	Shield Metal Arc Welding

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the weld puddle) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld.

Welding can classified many type. They are arc welding, brazing, oxyfuel gas welding, resistance welding, solid state welding, soldering and others. The popular one is arc welding. This is because this type is versatility; that mean it's readily applied to a variety of applications and a wide choice of electrodes. The most important is it has a low cost and easy to use. Welding also give many job and benefit to human.

Air extraction System must be working in a high efficiency to avoid the accident. This is because this system is function to extract the smoke during welding process especially for arc welding. The welder also needs a safety dress and protection such as glove, head cover, safety goggle, safety boot and etc. These gears will reduce the bad effect during welding process in the job site.

In a real world, welding is a popular step which means many people know how to do the welding process. Some people also make the welding for their minor money income and fully money income. This is because the salary for the welder is not so bad.

Unfortunately, welding also has an effect. Every year, thousands of welders suffer injuries as a result of accidents that occur because proper safety precautions are not followed at the job site. Accidents occur because of indifference to regulations, lack of information, or carelessness. Any injury can be painful and can incapacitate a person, or lead permanent disability or death.

The main effect of the welding is fumes or flux. Fumes are solid particles which originate from welding consumables, the base metal, and any coatings present on the base metal. Toxic gases may be used in, or generated by the process such as acetylene(C_2H_2), ozone (O_3), nitrogen oxides (NO), carbon monoxide (CO), generated when coatings on metal surfaces are heated such as epoxy resins, degreasing agents, paint and generated when the arc flash and some degreasing chemicals or paints react such as phosgene or phosphine. This gas is dangerous to the welder because its will effect the eyes and other body component. Fumes can cause symptoms such as nausea, headaches, dizziness, and metal fume fever. The possibility of more serious health effects exists when highly toxic materials are involved. For example, manganese overexposure can affect the central nervous system resulting in impaired speech and movement.

In addition to shielding gases that may be used, gases are produced during the welding process or may be produced by the effects of process radiation on the surrounding environment. Radiation is electromagnetic energy given off by the arc or flame that can injure eyes and burn skin. An operator sees visible light radiation. However, he does not see ultraviolet or infrared radiation. Radiation is often silent and undetected, yet injury occurs. Have all users learn about the effects of radiation. The effects of radiation depend on the wavelength, intensity, and length of time one is exposed to the radiant energy. Although a variety of effects is possible, the following two injuries are most common are skin burns and eyes damage.

Safety precautions are effective in reducing the occurrence of accidents at the job site. Safety means using common sense and avoiding serious accident. Established safety practices should be followed at all times. If good safety practices are consistently followed, an awareness of proper behavior is establish that usually prevents mistake.

1.2 PROBLEM STATEMENT

(i) The increasing level of accident and injuries among welding user at the job site. All of that effect can be painful and can incapacitate a person, or lead permanent disability or death.

(ii) Selection of the proper welding gear which following the specification of the welding safety.

1.3 OBJECTIVE OF THE PROJECT

(i) To design and fabricate the effectiveness of Air Extraction System.

(ii) To verify the effectiveness of Air Extraction System during welding process

(iii) To suggest;

- (i) Safety gear for welding bay.
- (ii) Safety gear from heat during welding process.

1.4 PROJECT SCOPE

This project is limited to the scope as follows;

(i) Research, Design and Fabricate the Air Extraction System.
(ii) Test-run and verify the Air Extraction System.
(iii) Research and suggest the safe protection during welding process.

1.5 REQUIREMENT

Hardware;

(i) Air Extraction System (for research),
(ii) Arc welding and complete welding apparatus including safe protection,
(iii) Computer and Computer Aided Design software.

Skill;

(i) Arc welding skill.
(ii) CAD skill (SolidWorks).
(iii) Fabrication skill.
(iv) Basic electrical knowledge.

CHAPTER 2

LITERATURE REVIEW

2.1 DEFINITION OF WELDING

Welding in its broadest sense can be defined as the process by which materials can be joined through the action of interatomic or intermolecular forces. Thus, welding, brazing, soldering and adhesive bonding can be considered welding processes. Soldering is a joining method that usees lead or tin based filler with a melting temperature not exceeding 450°C, and bonding is achieved by wetting of the base materials by the filler (solder). Brazing refer to joining using filler metals that have a melting point above 450°C, but well below the melting temperature of either base material joint.

A welded joint is produced (a) in the solid state by intimate direct contact under heat and/or pressure between the two materials being jointed, or (b) by melting and fusion of either side of the joint with or without a filler metal of melting point close to that of the base materials.

The earliest know welding process is probably the hammer or forge welding process. Over the years, several now ways of joining materials have evolved necessitated primarily by the stringent demands put on materials and their joints. Table 1 presents a complete list of various welding processes available today.

Table 2.1 Classification of Welding Processes

Group	Welding Process	
Arc Welding	Carbon arc	Electrogas
	Flux-cored arc	Gas metal arc
	Gas tungsten arc	Plasma arc
	Shielded metal arc	Stud arc
	Submerged arc	
Solid-state Welding	Cold welding	Diffusion welding
	Explosion welding	Forge welding
	Friction welding	Hot pressure welding
	Roll welding	Ultrasonic welding
Oxyfuel Gas Welding	Oxyacetylene welding	Oxyhydrogen welding
	Air acetylene welding	Pressure gas welding
Resistance Welding	Flash welding	Projection welding
	Resistance seam welding	Upset welding
	Resistance spot welding	
Other Welding Process	Electron beam	Electrolag
	Flow	Induction
	Laser beam	Percussion
	Thermit	

Focus to the learning institution of welding, they learn and practice the welding in a welding bay. Welding bay is design for a personal practice of welding especially at the institution which has welding learning and practice.

The overall size of the welding bay is 7feet to 10 feet wide and 5feet to 8feet long. This bay usually will have a welding apparatus for each bay. They also will have an Air Extraction System to extract the fumes which created during welding processes. This bay is exactly the best place to learn and practice welding process because that bay is a save and comfortable place to learn the welding process.

Figure 2.1: Sample of Welding Bay

2.2 FUMES AND GASES

Some of the welding, cutting, and allied processes produce fumes and gases, which may be harmful to your health. Fumes are solid particles which originate from welding consumables, the base metal, and any coatings present on the base metal.

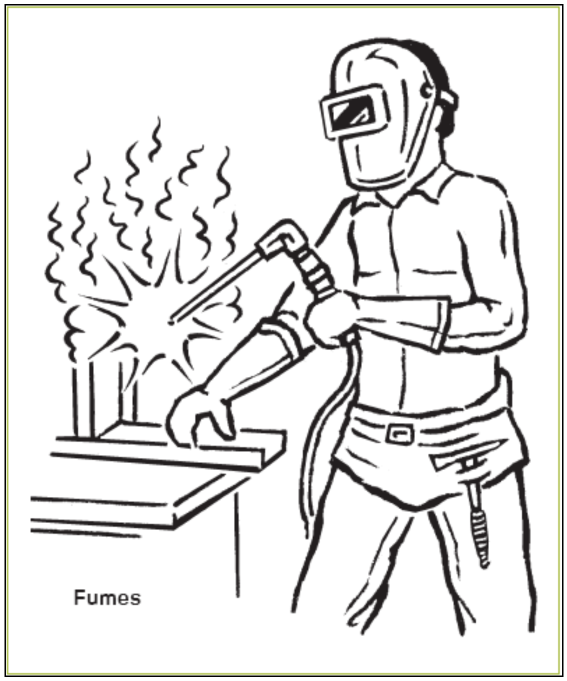

Figure 2.2: Fumes Shown during Welding Process

The welding exposure is unique. There is no material from any other source directly comparable to the composition and structure of welding fumes. However, the particulates and gases generated during welding are considered to be the most harmful exposure in comparison with the other byproducts of welding.

In addition to shielding gases that may be used, gases are produced during the welding process or may be produced by the effects of process radiation on the surrounding environment. Acquaint yourself with the effects of these fumes and gases by reading the Material Safety Data Sheets (MSDSs) for all materials used (consumables, base metals, coatings, and cleaners).

Table 2 Hazardous Byproduct of Welding

Fume	**Gases**	**Radiant Energy**	**Other Hazards**
Aluminum Cadmium Chromium Copper Fluorides Iron Lead Manganese Magnesium Molybdenum Nickel Silica Titanium Zinc	Carbon Dioxide Carbon Monoxide Nitrogen Oxide Nitrogen Dioxide Ozone	Ultraviolet Visible Infrared	Heat Noise Vibration

The amount and composition of these fumes and gases depend upon the composition of the filler metal and base material, welding process, current level, arc length, and other factors.

Many possible effects of over exposure will be shown. Depending on material involved ranges from irritation of eyes, skin, and respiratory system to more severe complications. Effects may occur immediately or at some later time. Fumes can cause symptoms such as nausea, headaches, dizziness, and metal fume fever. The possibility of more serious health effects exists when highly toxic materials are involved. For example, manganese overexposure can affect the central nervous system resulting in impaired speech and movement. In confined spaces the gases might displace breathing air and cause asphyxiation.

Overexposure must be ovoid to get the higher safety. First of all, keep your head out of the fumes and do not breathe the fumes. Use enough ventilation or exhaust at the arc, or both, to keep fumes and gases from your breathing zone and general area. In some cases, natural air movement provides enough ventilation and fresh air. Where ventilation is questionable, use air sampling to determine the need for corrective measures.

Use mechanical ventilation to improve air quality. If engineering controls are not feasible, use an approved respirator. Work in a confined space only if it is well ventilated, or while wearing an air supplied respirator. Fumes from Welding or cutting and oxygen depletion can alter air quality causing injury or death. Be sure the breathing air is safe. Follow OSHA guidelines for permissible exposure limits (PELs) for various fumes.

2.3 AIR EXTRACTION SYSTEM

Fume extraction system also call Air Extraction System is a system which to sniff up the fume and smoke during the welding. This is very important system in welding process because this system will sniff up the smoke which shown when welding process because of the carbon at the electrode. All of that is a toxin. Examples of toxins are ozone, carbon monoxide, nitrogen oxides and fumes from highly toxic metals including cadmium, zinc, beryllium, lead, chromium, nickel, manganese and copper.

Fumes from some of these metals can cause cancer. Inert shielding gases may pose risks of oxygen depletion and therefore suffocation, especially in confined spaces. Some welding gases present risks of fire and explosion. The Air Extraction System is a solution from this entire toxin because it sniffs up all of that around its area cover and take it at the safe condition.

Figure 2.3: Sample of Air Extraction System

Air extraction System has two types, fixed and portable Air Extraction System. Fixed air extraction is use in a welding room (bay) and the portable Air extraction System is use at the other welding process place because it can move to every place which wants to make a welding process.

Figure 2.4: Fix Air Extraction System

Figure 2.5: Portable Air Extraction System

2.4 SAFETY WELDING

Welding has many types of safety. All of it calls personal protective equipment (PPE). Standard personal protective equipment (PPE) for the variety of welding processes includes:

(i) Welding helmet with a suitable arc flash filter, not less than shade 10.

Figure 2.6: Welding Helmet with 10 Level Protection Shield

(ii) Welding gloves (AS/NZS 2161 – Occupational protective gloves).

(iii) Hearing Protective Devices -use hearing protective devices whenever ambient noise levels equal or exceed 85 dBa

Figure 2.7: Hearing Protection Devices

(iv) Respiratory protection – use to cover a nose from the fumes.

Figure 2.8: Respirator.

(v) Welding Leathers (apron) – Employees engaged in overhead welding or burning where severe burn hazards exist must wear leather gloves, chrome-tanned leather chaps and coats, or a combination that provides equal protection to prevent exposure to sparks and slag. They must wear leather gloves and aprons when performing routine welding and burning.

(vi) Foot Protection - safety shoes and boots provide both impact and compression protection. (AS/NZS 2210 Guide to occupational protective footwear). ANSI Z41, "American National Standard for Personal Protection-Protective Footwear".

(vii) Additional items of protective clothing may include:

(i) A cap
(ii) Neck covering (for protection from arc flash in confined spaces)
(iii) Spats or leggings
(iv) Steel-capped boots (AS/NZS 2210 Guide to occupational protective footwear).

Additional respiratory protection may be required (e.g. when welding galvanized metal or when cadmium is present in welding rods). This may range from simple filter masks that fit under the welding helmet to powered air purifying respirators. Specialist help may be needed to select, fit and maintain these items.

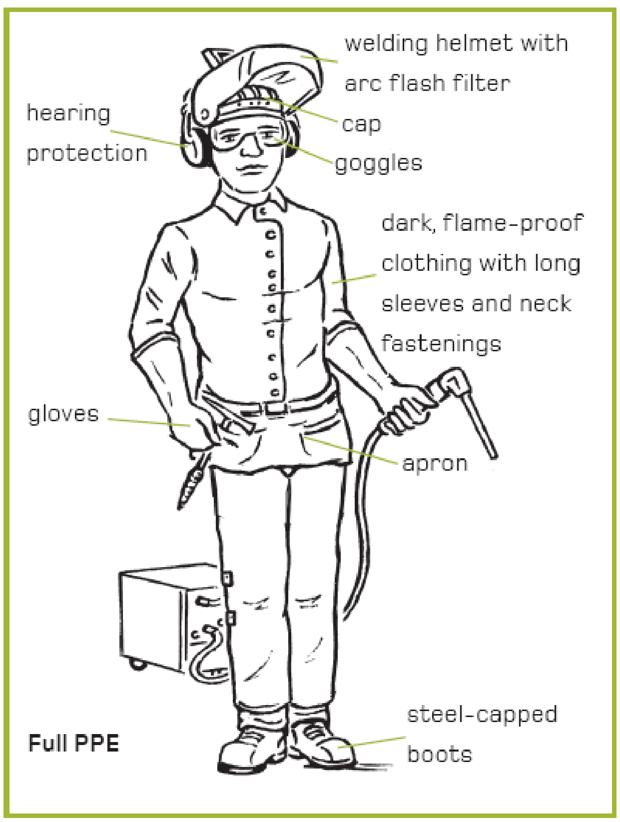

Figure 2.9: Full Personal Protective Equipment (PPE)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In order to complete a research, methodology is the one of the most important thing to be considered to make sure that the thesis or research run smooth and will get expected result which is needed. Methodologies also use to determine the research follow the objective that had been stated earlier or in other word, to follow the guideline based on the objective.

In methodology, the structure of the research is a significant thing that should be considered. Methodology also can be described as a framework of the research that contains the elements of work based on the scope and the objectives. Frameworks also use to facilitate the supervisor to view the overall process of the research. Any mistaken or default can be correcting and adding the elements which lacking in the research.

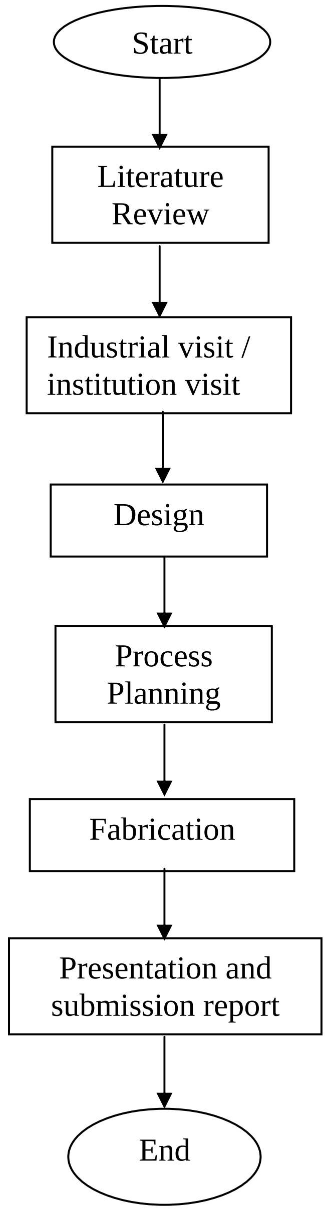

Figure 3.1: Flowchart of the Methodology

3.2 LITERATURE REVIEW

To start this project, it is important to understand the title of the project which is effective Air extraction System and safe protection for welding bay in institution in higher learning. The scope and objective of this project also the important thing to consider and comprehend properly.

In order to get the right and precision of information to complete this project it is important to get the right source of information in doing this literature review. That information which gets from the certain source must be accurate and useful for this project. There are the certain methods to get the information in order to complete the literature review.

(i) Surfing the internet
(ii) Book
(iii) Discussion with supervisor

3.2.1 Internet

Internet is the one of the most important source to complete this project. It became the main source due to the information regarding to this title widely spread at the internet. But not all the information from the internet is believable. That’s why the majority the information is getting from internet journal such as science direct journal.

3.2.2 References Books

The information about the tailor welded blank and the welding process also getting from the reference books. The information is getting from the references books is believable. Because the books written by professional person such as professor outstanding researcher.

3.2.3 Discussion with Supervisor

Even the information is getting from the internet and the books is enough; discussion with the supervisor also important to make sure that the information which had gathered from the books and the internet is correct and useful to the project. Correct information is important because valid data come from the accurate information. Furthermore with the discussion can generate new ideas and exchange of thought about the research so that the title of the research can be more clear and understandable.

3.3 INSTITUTION VISIT

The next step after make some literature review about this project is the institution visit. Two institutions which in list is;

(i) Welding Lab, Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu.
(ii) Welding Department, Institut Latihan Perindustrian Pengkalan Chepa, Kota Bharu, Kelantan.

First visitation is at Politeknik Sultan Mizan Zainal Abidin. The date is 17^{th} February 2008 at 10am to 12pm and the person in charge when visitation is Mr. Zaidi Bin Endut, Head Officer of that welding lab. The second visitation is at Institut Latihan Perindustrian Pengkalan Chepa. The visitation begun at 24^{th} February 2008 at 10am to 12pm and the person in charge at that visitation is Mr Azmi Bin Mohd Nor, Head Officer of Welding Department there.

3.4 DESIGN

To complete the experiment of this research is fabricate the portable Air Extraction System. First step to do this is making some research about this project. The next step is sketching. All of side view with the dimension must be tolerate to reduce the problem error for the next step. After that make a 3D drawing with SolidWorks 2007, one of the computer aided design (CAD) software. This step is important to know the overall design that will fabricate.

3.5 PROCESS PLANNING

This step is familiar before doing the fabrication process because this step will consider the detail information about the fabrication such as material type, specific equipment will be use, step of fabrication and the due date of the project.

3.6 FABRICATION

This is the hardest part of this project. First of all, find the right material that will be fabricated. Then the next step is making a frame of the system. This is the important part because it will be a guideline of the project fabricate. ‘L’ shape stainless steel is using to make this. The angle of the jointer part must be 90° and its must apply to all jointer part. Make sure the dimension still in the scale.

Figure 3.2: Frame of the Project

The next step is shearing the sheet metal plate following the dimension from the drawing. This plate will cover all the surface of the project. This time, dimension must be accurate to make it fix at the frame. So that the linkage of air can be reduce. All the shearing process was using Shearing Machine.

Figure 3.3: Shearing Machine

Figure 3.4: Sheet Metal Plate after Shearing Process

After that, assemble all the sheet metal plate to the frame using welding process. Arc welding type is chosen because of level of strong joint. In the same time, the main fan of the project will be installing at the middle of the frame. The function of this fan is it will be a medium of fume extraction process. Electronic part with this fan also must install in the same time.

Figure 3.5: The Extraction Fan in the Middle of the Frame

Then, complete the assembling part with the hose at the top bottom of the system. In the other side, this hose must been fix with the hood at the end of the hood before it install at the main body of the project. The next step is fabricated the adjustable support of that hose. It will fix at the front of the project. The function of this support is to control the position of the hood in term of distance and angle.

Figure 3.6: Body of the Project with Hose and Adjustable Support

The final step for the fabrication is a painting process. This step is very important because this process will show the final color of the project. Many layer of painting was needed to make a good quality of the color. First of all, surface of the project must be clean up with the sand paper to improve the quality of the surface. After that, clean it with a span to make sure the body doesn’t have any dirt.

Figure 3.7: After Clean-Up using Sand Paper and Span

Then, cover all the part which no need to painting with a paper. This is important to make sure the part such as tires, electronic part, grill and others will maintain with the original color.

Figure3.8: Cover the Part which not been Paint

The painting process will available after this step. First and second layer of the painting process must be with white color. This is because the white color is a premium of all color. Important tips in painting process is before the next layer of painting, make sure that the surface and part which be painting before was dry. If the surface was dry, the quality of the painting will be increase.

Figure 3.9: First Layer of Painting Process

After the second layer with white color, the next step of color is color of the body. That means third and forth layer of color will be paint with blue color, the secondary color.

Figure 3.10: Third Layer of Painting Process

The last step is paint the black color at the other part of body which doesn't have a secondary color. Hose also must been painting with the applicable color. For this step, many layers of painting are required to make a good quality of color. It will take some time to complete this step. Finally the Air extraction System is completely finished like a figure below.

Figure 3.11: Air extraction System after Painting Process

3.7 TESTING

The next step is testing. Air extraction System will be test with something that has a fume for the first time. Then, make some experiment using this project with follow the variable given;

(i) Distance of the fume with hood
(ii) Angle of the starting fume respect to hood
(iii) Quality of welding structure

3.8 DATA COLLECTION

This is one of the most important steps in the research because every data that have been collected must be accurate and valid for the research. The process of collection data is done while doing the test. For this experiment, data will collect with take a picture that will show the direction of fume before it extract into Air extraction System. The picture will be taken every distance and angle to make sure the result is accurate.

3.9 COMPARISON AND CONCLUSION

After the test and investigation had finished, the data will be collected and will be analyzed in order to get the best result. Comparison will be done between every distance of the experiment, every angle that considered and every quality of welding structure that was testing. The discussion based on the scope and the objective of this investigation.

3.10 PROGRESS CONCLUSION

There are nine steps needed to complete this project, it including literature analysis, discussion with supervisor, identify the problem and provide solution, design the portable Air extraction System, proposed the best design of the portable Air extraction System, fabrication, troubleshooting and comparison, run the product testing, and conclusion. All of this steps must be done properly and follow the time schedule.

As the conclusion, all of the steps need to be follow and done in time in order to archive the best result and successfully complete the PSM project. Any mistake and misunderstanding must be avoided or settled as soon as possible because it will effect the overall process flow in the system, the result may be able to not be archive as expected.

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

In this chapter, the result of the testing using portable air extraction system will be assesses due to the variable of the project that decided earlier. For this experiment, data will collect with take a picture that will show the direction of fume before it extract into air extraction system.

The picture will be taken every distance and angle to make sure the result is accurate. The result of the experiment will be shown in figure below. Every distance and angle will be show in difference picture. The quality of welding structure also will be taken in difference picture to make it clear that the difference distance of welding stage and hood will give an effect the welding structure.

4.2 SPECIFICATION

Fan of the air extraction system is only one speed capacity. Specification of the fan was given. Power that will use for this fan is 50W and the diameter of a fan is 8 inch / 20 cm. The flow rate given is 0.2 m^3 / s.

The hood that use at the air extraction system is 20 cm, which mean it is same size of the ventilation fan. So the flow rate at the hood will consider same at the fan, 0.2 m^3 / s. This experiment also uses the joss stick as a fume source. It was a same function with a source like a fume that comes during welding process.

4.3 LOW FUME CAPACITY WITH 90° OF ANGLE

First of all, the experiment will use the low fume of sources with 90° of angle. This experiment is focus to the welding process such as gas tungsten arc welding or also called TIG welding that only makes a low quantity of fume.

4.3.1 10cm of Distance

The first step is setting the hood with distance 10cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.1: Fume Flow at 10cm Distance of Hood at 90° angle

From the figure 4.1, the flow of the fume just come up straight go through to the hood. This is because extraction of air in the system is quit strong and can extract the entire fume which comes from the fume source.

4.3.2 20cm of Distance

Set up the hood with distance 20cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.2: Fume Flow at 20cm Distance of Hood at 90° angle

From the figure 4.2, the flow of the fume still come up straight go through to the hood. However, the direction of the fume starts to be a laminar before its go into that hood. This is because extraction of air in the system is not so strong but still can extract the entire fume which comes from the fume source.

4.3.3 30cm of Distance

Set up the hood with distance 30cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.3: Fume Flow at 30cm Distance of Hood at 90° angle

From the figure 4.3, the flow of the fume not comes up straight goes through to the hood. The flow also starts to turbulence. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. But around 50% of the fume can extract into the hood.

4.3.4 40cm of Distance

Set up the hood with distance 40cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.4: Fume Flow at 40cm Distance of Hood at 90° angle

From the figure 4.4, the flow of the fume not comes up straight goes through into the hood. The flow also turbulence shapes. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. But around 30% to 40% of the fume can extract into the hood.

4.3.5 50cm of Distance

Set up the hood with distance 50cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.5: Fume Flow at 50cm Distance of Hood at 90° angle

From the figure 4.5, the flow is most totally not going into the hood. The flow also high level of turbulence shapes. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. But around 10% to 20% of the fume can extract into the hood.

Table 4.1 Summary of Low Fume Capacity with 90° of Angle

Distance	**Comment**	**Status**
10 cm	The entire fumes go through into the hood	Very Good
20 cm	Most of fumes go through into the hood	Good
30 cm	Around 50% of the fume can extract into the hood	Good
40 cm	Only 30% to 40% of the fume can extract	Poor
50 cm	Only 10% to 20% of the fume can extract	Very Poor

4.4 HIGH FUME CAPACITY WITH 90° OF ANGLE

This step of the experiment will use the high fume of sources with 90° of angle. This experiment is focus to the welding process such as shield metal arc welding (SMAW) that produce high quantity of fume.

4.4.1 10cm of Distance

Set up the hood with distance 10cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.6: Fume Flow at 10cm Distance of Hood at 90° angle

From the figure 4.6, the flow of the fume just come up straight go through to the hood. This is because extraction of air in the system is quit strong and can extract the entire fume which comes from the fume source.

4.4.2 20cm of Distance

Set up the hood with distance 20cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.7: Fume Flow at 20cm Distance of Hood at 90° angle

From the figure 4.7, the flow of the fume still come up straight go through to the hood. It’s same like using low source of fume. However, the direction of the fume starts to be a laminar before its go into that hood. This is because extraction of air in the system is not so strong but still can extract the entire fume which comes from the fume source.

4.4.3 30cm of Distance

Set up the hood with distance 30cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.8: Fume Flow at 30cm Distance of Hood at 90° angle

From the figure 4.8, the flow of the fume not comes up straight goes through to the hood. The flow also starts to turbulence. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. But around 60% of the fume can extract into the hood.

4.4.4 40cm of Distance

Set up the hood with distance 40cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.9: Fume Flow at 40cm Distance of Hood at 90° angle

From the figure 4.9, the flow of the fume not comes up straight goes through into the hood. The flow also turbulence shapes. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. But around 40% to 50% of the fume can extract into the hood.

4.4.5 50cm of Distance

Set up the hood with distance 50cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.10: Fume Flow at 50cm Distance of Hood at 90° angle

From the figure 4.10, the flow is most totally not going into the hood. The flow also high level of turbulence shapes. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. But around 15% to 25% of the fume can extract into the hood.

Table 4.2 Summary of High Fume Capacity with 90° of Angle

Distance	**Comment**	**Status**
10 cm	All fumes go through into the hood	Very Good
20 cm	Most of fumes go through into the hood	Good
30 cm	Around 60% to 70% of the fume can extract into the hood	Good
40 cm	Only 40% to 50% of the fume can extract	Good
50 cm	Only 15% to 25% of the fume can extract	Poor

4.5 HIGH FUME CAPACITY WITH 45° OF ANGLE

Experiment of this type more focus to the angle of the hood from the fume source. This is because many designs an angle of the hood from the welding state was create nowadays. 45° of angle was chosen because this angle is in the middle of the 0° and 90°. This experiment will show the effectiveness of the angle as a variable.

4.5.1 10cm of Distance

Set up the hood with distance 10cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.11: Fume Flow at 10cm Distance of Hood at 45° angle

From the figure 4.11, the flow of the fume just come up straight go through to the hood. This is because extraction of air in the system is quit strong and can extract the entire fume which comes from the fume source.

4.5.2 20cm of Distance

Set up the hood with distance 20cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.12: Fume Flow at 20cm Distance of Hood at 45° angle

From the figure 4.12, the flow of the fume still come up straight go through to the hood. It's same like using 45° of angle from hood to fume source. However, the direction of the fume starts to be a laminar before its go into that hood. This is because extraction of air in the system is not so strong but still can extract the entire fume which comes from the fume source.

4.5.3 30cm of Distance

Set up the hood with distance 30cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.13: Fume Flow at 30cm Distance of Hood at 45° angle

From the figure 4.13, the flow of the fume not comes up straight goes through into the hood. The flow also turbulence shapes. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. The major fume was go straight upward and only a minor fume was extract into the hood. But around 30% to 40% of the fume can extract into the hood.

4.5.4 40cm of Distance

Set up the hood with distance 40cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.14: Fume Flow at 40cm Distance of Hood at 45° angle

From the figure 4.14, the flow of the fume not comes up straight goes through to the hood. The flow also starts to turbulence. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. The major fume was go straight upward and only a minor fume was extract into the hood. Around 20% to 30% of the fume only can extract into the hood.

4.5.5 50cm of Distance

Set up the hood with distance 50cm from the fume source with a hood of air extraction system. Make a fume source come out first and start the air extraction system. Let it function at least 2 minutes to stabilize the fume direction. After that, take a picture that shows the flow of that fume.

Figure 4.15: Fume Flow at 50cm Distance of Hood at 45° angle

From the figure 4.15, the flow is most totally not going into the hood. The flow also high level of turbulence shapes. This is because the power of extraction system was not quit enough to extract the fume from the source to go thought into the hood. The major fume also was go straight upward and only a minor fume was extract into the hood.

Table 4.3 Summary of High Fume Capacity with 45° of Angle

Distance	**Comment**	**Status**
10 cm	The entire fumes go through into the hood	Very Good
20 cm	Most of fumes go through into the hood	Good
30 cm	Around 30% to 40% of the fume can extract into the hood	Poor
40 cm	Around 20% to 30% of the fume only can extract into the hood	Poor
50 cm	Only a minor fume was extract into the hood	Very Poor

4.6 STRUCTURE OF WELDING WITH HIGH FUME CAPACITY WITH 90° OF ANGLE

This type of experiment is to determine the structure of welding after using this air extraction system. This structure can be disturbed if level of temperature at welding spot is under the standard welding temperature. This phenomenon can be happen because of the flow that made from the system will drop the surrounding temperature.

4.6.1 10cm of Distance

Set up the distance of the hood from the workpiece at 10cm. Switch ON the air extraction system and start the welding process. After finish the welding process, picture was taken to prove this experiment as a data.

Figure 4.16: Welding Structure with 10cm Distance

From the figure 4.16, the structure of the welding is totally disturbing from the flow of air extraction system; that mean the temperature of welding zone and current flow was disturbing. This is because the distance of hood is very close to the workpiece. The temperature is exactly was under the standard temperature.

4.6.2 20cm of Distance

Set up the distance of the hood from the workpiece at 20cm. Switch ON the air extraction system and start the welding process. After finish the welding process, picture was taken to prove this experiment as a data.

Figure 4.17: Welding Structure with 20cm Distance

Form the figure 4.17, the structure of welding show the unstable in certain side of welding. This phenomenon happened because of the welding temperature was disturbing a little. For the 20cm distance, the flow from air extraction system only can drop a little temperature during welding process.

4.6.3 30cm of Distance

Set up the distance of the hood from the workpiece at 30cm. Switch ON the air extraction system and start the welding process. After finish the welding process, picture was taken to prove this experiment as a data.

Figure 4.18: Welding Structure with 30cm Distance

From the figure 4.18, the structure is completely don’t disturb from the flow of air extraction system. This is because that flow only can extract the fume at the bottom of the welding area but can’t extract the fume around the welding zone. In this distance, the welding process will be the best distance in order of disturbing the welding structure.

4.6.4 40cm of Distance

Set up the distance of the hood from the workpiece at 40cm. Switch ON the air extraction system and start the welding process. After finish the welding process, picture was taken to prove this experiment as a data.

Figure 4.19: Welding Structure with 40cm Distance

From the figure 4.19, the structure is completely doesn’t disturb from the flow of air extraction system. This is because that flow only can extract the fume at the bottom of the welding area but far away to extract the fume around the welding zone. In this distance, the welding process will be safe from temperature drop when using the air extraction system during welding process.

4.6.5 50cm of Distance

Set up the distance of the hood from the workpiece at 50cm. Switch ON the air extraction system and start the welding process. After finish the welding process, picture was taken to prove this experiment as a data.

Figure 4.20: Welding Structure with 50cm Distance

From the figure 4.20, the structure is completely never disturbed from the flow of air extraction system. In this distance, the welding structure will never disturb from the flow but it will affect the safety of the welder because in this distance, the air extraction system only can extract a few of fume that exist from welding process. This condition is not good for welder because it will give a bad effect if the welder exposed to the fume in a high quantity. This factor also must been alert to make sure the safety of the welder is not disturbing.

Table 4.3 Summary of Structure Welding with High Fume Capacity with 90° of Angle

Distance	Comment	Status
10 cm	Unstable flow of welding and defect was occur at welding structure	Poor
20 cm	Unstable flow of welding but don’t have a defect on welding structure	Good
30 cm	Structure doesn’t have a defect but welding process is harder.	Good
40 cm	Structure don’t have any sign of defect	Very Good
50 cm	Structure was totally don’t disturbed from the flow at the hood	Very Good

CHAPTER 5

CONCLUSION

5.1 Conclusion

The main objective of this study is to design and fabricate the effective of air extraction system, to verify the effectiveness position and distance of air extraction system during welding process and to suggest the safety gear of welding bay, safety gear from heat during welding process and safety dressed. This study showed the important of the Air extraction System, the effective position of hood at Air extraction System, and the safety gears of the welding during the welding process.

This study was completely achieving the objective. The Air extraction System must work in high efficiency during welding process to avoid the bad effect from the fume, heat and radiation. The lower of the level of hood from welding surface is better in term of extract the fume but not so good for welding structure. The best position is around 20cm to 30cm because it will extract most of the fume and it also does not disturb the welding structure. The vertical position (90°) of the hood is more effective than other angle especially the horizontal position. The welder also must follow the full Personal Protection Equipment (PPE) for welding during welding process.

5.2 Recommendation

The institution which wants to have a welding learning must have a welding bay as their place to learn. More wide of welding bay is more comfortable to student in learning process. The welding bay must have an Air Extraction System to extract the fume. In order to make it more effectively of their welding bay, they must:

(i) Make sure the Air extraction System always works in high efficiency.
(ii) The hood of the Air extraction System must be flexible.
(iii) The safety gears welding must place at each welding bay.
(iv) Must try to achieve the standard of Personal Protective Equipment (PPE).

All of this thing will improve the safety of welding and automatically will reduce the accident during welding process.

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APPENDICES A – GANTT CHART

Contents	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16
Literature Review	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FYP 1 Briefing		X														
First Draft Proposal			X	X												
Submit Proposal					X											
Process Planning						X	X	X								
FYP 1 Visit									X	X	X					
Interpretation & Recommendations												X				
Submit Proposal Process													X	X		
Presentation & Submit Full Report															X	X

Gantt Chart for Final Year Project 1

Contents	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
3D Drawing	X	X												
Verify with CAD			X											
Process Planning				X	X									
Fabrication					X	X	X	X	X					
Testing & Verifying										X	X			
Interpretation & Recommendations											X			
Prepare Presentation										X	X			
Writing FYP2 Report								X	X	X	X	X	X	
Presentation & Submit Full Report												X	X	X

Gantt Chart for Final Year Project 2

APPENDICES B – INSITTUTION VISIT

UMP
UNIVERSITI MALAYSIA PAHANG
Dahulunya dikenali sebagai Kolej Universiti Kejuruteraan & Teknologi Malaysia (KUKTEM)
KARUNG BERKUNCI 12, 25000 KUANTAN, PAHANG DARUL MAKMUR. TEL: 09-549 2233 FAKS: 09-5492244

FAKULTI KEJURUTERAAN MEKANIKAL

RUJ. KAMI (OUR REF.) : UMP/FKM/13.12/2 (18) 29 Januari 2008
RUJ. TUAN (YOUR REF.) :

Pengarah,
Politeknik Sultan Mizan Zainal Abidin,
Km 8 Jln Paka,
23000 Dungun,
Terengganu Darul Iman.

(u.p. : Tuan. Hj. Abdul Karim bin Awang Kechik)

Tuan,

LAWATAN KE MAKMAL KEJURUTERAAN MEKANIKAL (BAHAGIAN KIMPALAN)

Merujuk kepada percakapan saya dengan Tuan Haji mengenai perkara tersebut di atas, saya terlebih dahulu mengucapkan terima kasih di atas kesudian pihak tuan membenarkan empat orang pelajar saya melawat makmal tuan.

2. Tujuan sebenar lawatan ini adalah untuk mendapat gambaran yang jelas dan mengumpul maklumat untuk Projek Sarjana Muda di Universiti Malaysia Pahang.

3. Berikut adalah perincian lawatan tersebut;

3.1	Ketua Rombongan	: Mohd Khairul Jeffridin Bin Daud : (013-9939121)
3.2	Tarikh	: 17 Februari 2008 : 10.00pg. – 12.00 tgh. Hari.
3.3	Hari	: Ahad
3.4	Bil. Pelawat	: 4 orang (Termasuk Ketua)

4. Kerjasama daripada pihak tuan saya ucapkan ribuan terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan tugas,

LEE GIOK CHUI
Pensyarah
Fakulti Kejuruteraan Mekanikal
Tel : 549 2203

ML/Lin_Projek Sarjana Muda (Ijazah)

www.ump.edu.my

Application latter to visit Mechanical Lab at Politeknik Sultan Mizan Zainal Abidin.

UMP
UNIVERSITI MALAYSIA PAHANG
Dahulunya dikenali sebagai Kolej Universiti Kejuruteraan & Teknologi Malaysia (KUKTEM)
KARUNG BERKUNCI 12, 25000 KUANTAN, PAHANG DARUL MAKMUR. TEL: 09-549 2233 FAKS: 09-5492244
MS ISO 9001 : 2000 REG. NO. AR38

FAKULTI KEJURUTERAAN MEKANIKAL

RUJ. KAMI (OUR REF.) : UMP/FKM/13.12/2 (17) 29 Januari 2008
RUJ. TUAN (YOUR REF.) :

Pengarah,
Institut Latihan Perindustrian,
Kaw. Perindustrian Pengkalan Chepa,
16100 Pengkalan Chepa, Kota Bharu,
Kelantan Darul Naim.

(u.p : Pn. W. Fadzilah binti W. Dagang)

Tuan,

LAWATAN KE WORKSHOP KIMPALAN ARKA & GAS

Merujuk kepada percakapan saya dengan En. Azmi bin Mohd Nor mengenai perkara tersebut di atas. Saya terlebih dahulu mengucapkan terima kasih di atas kesudian pihak tuan membenarkan seorang pelajar saya melawat workshop tuan.

2. Tujuan sebenar lawatan ini adalah untuk mendapat gambaran yang jelas dan mengumpul maklumat untuk kajiannya dalam Projek Sarjana Muda di Universiti Malaysia Pahang.

3. Berikut adalah perincian lawatan tersebut :

3.1	Nama	: Mohd Khairul Jeffridin Bin Daud
		: (013-9939121)
3.2	Tarikh	: 24 Februari 2008
3.3	Hari	: Ahad 10.00pg. – 12.00tgh. hari

4. Kerjasama daripada pihak tuan amat kami harapkan dan diucapkan ribuan terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan tugas,

LEE GIOK CHUI
Pensyarah
Fakulti Kejuruteraan Mekanikal
Tel : 549 2203

ML/Lin_Projek Sarjana Muda (Ijazah)

Application Latter to Visit Arc & Gas Welding workshop at Institut Latihan Perindistrian Pengkalan Chepa, Kelantan

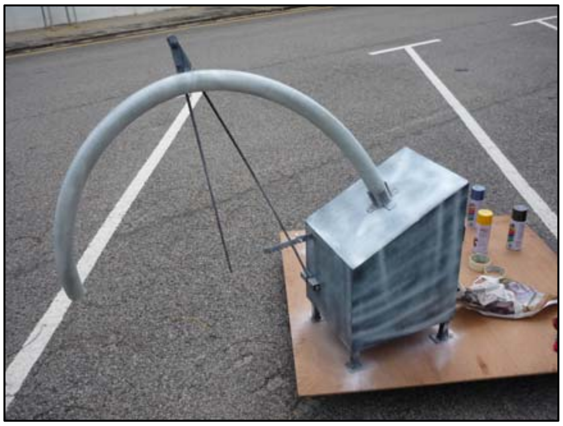
APPENDICES C – FABRICATION PROCESS

Frame of Air Extraction System

Fan inside Frame Body

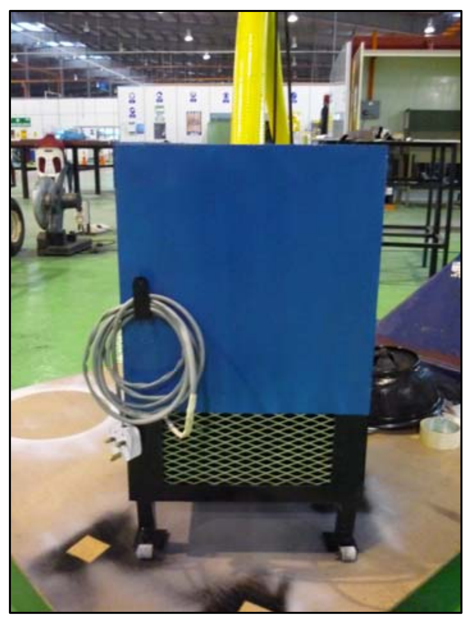
Wiring Management
Hose

Air Extraction System with



1st Layer of Painting Process

Painting the Body of Air Extraction System



Front View

Back View

Complete Portable Air Extraction System