DESIGN A SMOKE FILTER CONTROL SYSTEM IN FISH BURNING FURNACES TO REDUCE THE IMPACT OF AIR POLLUTION

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Abstract— Smoke filter technology using electrostatic preciptitator (ESP) is one of the methods of reducing smoke using copper slabs supplied with high voltage DC electricity. Voltage input comes from PLN 220 AC and converted into DC voltage and raised using flyback converter. When smoke passes through a negatively charged copper plate there will be irradiation and when it passes through a positively charged copper plate the smoke particles will be reduced. Used 2 carbon monoxide gas sensors to determine the success of the smoke filter system using electrostatic preciptitator, the system succeeds if the second sensor reading value is not more than 101 ppm (part per million) according to those determined by the local government so that it is safe for the environment. The quality of exhaust carbon monoxide (CO) gas emissions from the processing of this plant is better at about 31.46 ppm than 615.92 ppm (part per million) and can reduce the impact of air pollution produced by home industry despite the use of copper plates supplied by high voltages. Dust particles contained in smoke are able to filter about 0.18gram within 330 minutes. The reading results will be displayed on blynk as a form of monitoring.

Keywords— Smoke Filtration Technology, Electrostatic Preciptitator, Appropriate Technology.

1. INTRODUCTION

Bandeng fish is one of the fishery products in Kalanganyar Village, Sedati District, Sidoarjo Regency, East Java [1]. Most of the population is working as farm farmers and processing processed smoked fish, presto, Otak-Otak and grilled fish with small scale (household) [2]. Smoked fish is a processed product that is ready for consumption [3] . The process of burning or smoking in addition to making fish mature, can also preserve fish because it comes from several chemical compounds contained during the smoking process [4]. Long burning or smoking for processed fish bandeng takes 8 hours for fish without thorns and 12 hours of smoking for fish bandeng with thorns [5].

A common environmental impact resulting from smoked fish processing activities is air pollution due to the smoke that is emp. Air pollution caused by the burning or smoking of fish business has a huge impact on the environment and disturbs the surrounding communities [6]. Coconut shell smoke compounds consist of dominant phenol (34.45%), dimethoxy phenol (12.58%), and methoxy phenol (9.81%) [7]. Smoke discharged into the air contains chemical compounds that have the potential to cause decreased lung function in the form of particulates and can result in coughing, shortness of breath and pain in the chest [6].

To solve this problem, a smoke filtration system is required in the combustion furnace. The smoke filtration system in this combustion furnace works by capturing the combustion or smoking smoke from coconut shell-fueled fish. The smoke will enter the electrostatic precipitator to be given a negative charge, then the copper plate will be fed a positive charge so that the ionized smoke in the electrostatic precipitator can be pulled and attached due to differences in positive and negative charge [7]. After it has passed the filtration process, the smoke will be measured ppm (Part Per Milion) level whether it is safe in accordance with the standards determined by the sidoarjo local government [8].

2. METHOD

2.1. The research Flow Chart

The research procedure is shown in the following figure 1 below.

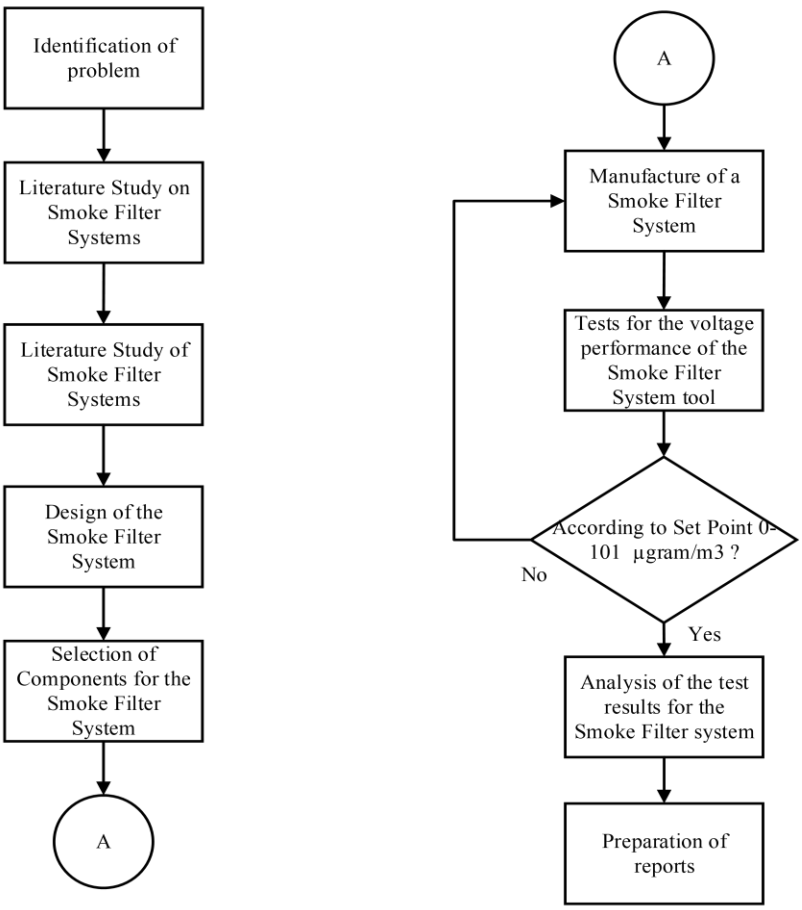

Figure. 1. The flow chart of research

The flow chart shows the progress of this final project research. The procedure of this final project begins by identifying the problem under study, namely the smoke filter control system in the milkfish combustion furnace. Then proceed with conducting literature studies and literature studies looking for articles and research journals regarding the Electrostatic Precipitation smoke filtration system, then designing the smoke filter system design and then selecting the smoke filter components so that the system runs as expected. After selecting the components followed by the design of the smoke filter system, there are two parts to the smoke filter system design, namely the filter design using a copper plate and software.

2.2. Smoke Filtration System Design and Specification

The smoke filter system in the burning furnace or smoking of the bandeng fish has several main parts namely copper plate, Teflon insulator, MQ7 carbon monoxide (CO) gas sensor, flyback converter. There are two hardware designs, namely mechanical design and electronic design. In mechanical design there is a smoke filter plant. While in electronic design there are several components such as the design of carbon monoxide gas sensor (CO), Arduino mega ESP8266 as controller, step-up voltage, DC supply 12 Volt and transistor. Arduino mega ESP8266 serves as a controller and performs sensor sensing results readings while sending the processed sensor readings to Blynk for monitoring. The result of designing a smoke filter system as shown in figure 2 below.

Figure. 1. The result of designing hardware and electrical

2.3. Wiring Design for Smoke Filter System

The wiring design of the smoke filter system so that the system can work properly can be represented in Figure 3 below.

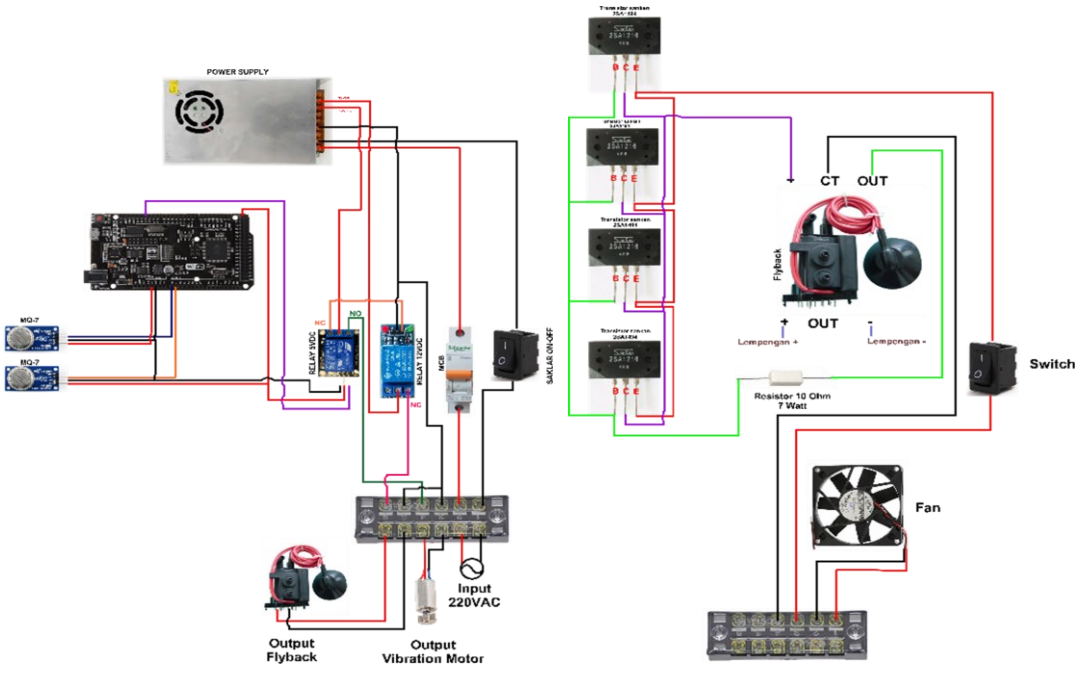

Figure. 2. Wiring Design for Smoke Filter System

Wiring design consists of sensor design and voltage step-up design. In the design of the sensor before it is connected to the Arduino Mega ESP8266 is required to perform a firmware update that aims to activate the functionality of the ESP8266. The MQ7 VCC sensor is connected with a 5v pin on the Arduino that serves as the input voltage, then the GND leg is connected with the ground pin on the Arduino and the output analog pin (AO) is connected to the A0 pin on the Arduino, as well as the second sensor. Relays are used to activate the motor as well as smoke filters to alternately activate. used power supply 12 Volt DC 10 ampere for voltage source on smoke filter system. To shake the copper slab so that the particles attached to the filter can fall, the joystick motor is used. This joystick motor will be controlled by Arduino who will later order the relay to activate the joystick motor. Voltage step-up design using flyback components. Transistors are used for amplifiers, stabilizing voltages and others

3. RESULT AND DISCUSSION

Testing on smoke filter system using 2 stages, namely the test stage of smoke sensor calibration components and the copper filter absorption capability test stage. In the smoke sensor test was conducted testing by determining a fixed value on the calibrator and compared to the output value read by the smoke sensor. the calibrator used in smoke sensor testing is a CO Meter with a maximum reading of 1000ppm. The test results of sensor 1 and sensor 2 are shown in tables 1 and 3, for the characteristic results shown in tables 2 and 4 below.

Table 1. Validation results of smoke sensor 1

No	Calibrator (ppm)	Measure (ppm)	Error	(X'-X)	(X'-X) ^2
1	6	6.36	-0.360	0.025	0.00063
2	6	6.02	-0.020	-0.315	0.09923
3	6	6.15	-0.150	-0.185	0.03422
4	6	6.41	-0.410	0.075	0.00563
5	7	6.93	0.070	0.595	0.35403
6	6	6.22	-0.220	-0.115	0.01323
7	6	6.29	-0.290	-0.045	0.00202
8	6	6.43	-0.430	0.095	0.00902
9	6	6.15	-0.150	-0.185	0.03422
10	7	6.39	0.610	0.055	0.00302

From the data above can then be known the characteristics of the sensor 1 as follows table 2 below.

Table 2. Sensor characteristic result sensor 1

Description	Result
Resolution	0.01 ppm
Mean	6.335 ppm
Standard Deviation	0,248383664
Calibrator uncertainty	0.2 ppm
Level of Trust	95%
Coverage Factors	1,8
accuracy	2%
Raw uncertainty	0,078545811
Mathematical Model	6,200 ± 0,412731
Uc	0.229 ppm
U95	0.413 ppm

Table 3. Validation results of smoke sensor 2

No	Calibrator (ppm)	Measure (ppm)	Error	(X'-X)	(X'-X) ^2
1	6	6	0.000	-0.208	0.00063
2	6	6.22	-0.220	0.012	0.09923
3	7	6.57	0.430	0.362	0.03422
4	6	6.09	-0.090	-0.118	0.00563
5	6	6.02	-0.020	-0.188	0.35403
6	7	6.89	0.110	0.682	0.01323
7	6	6.02	-0.020	-0.118	0.00202
8	6	6.02	-0.020	-0.118	0.00902
9	6	6.58	0.110	-0.318	0.03422
10	6	6.63	-0.360	0.152	0.00302

From the data above can then be known the characteristics of the sensor 2 as follows table 4 below.

Table 2. Sensor characteristic result sensor 1

Description	Result
Resolution	0.01 ppm
Mean	6.208 ppm
Standard Deviation	0.313361701
Calibrator uncertainty	0.2 ppm
Level of Trust	95%
Coverage Factors	1,8
accuracy	2%
Raw uncertainty	0.099093671
Mathematical Model	6,200 ± 0.3824593
Uc	0.212477384 ppm
U95	0.382459292 ppm

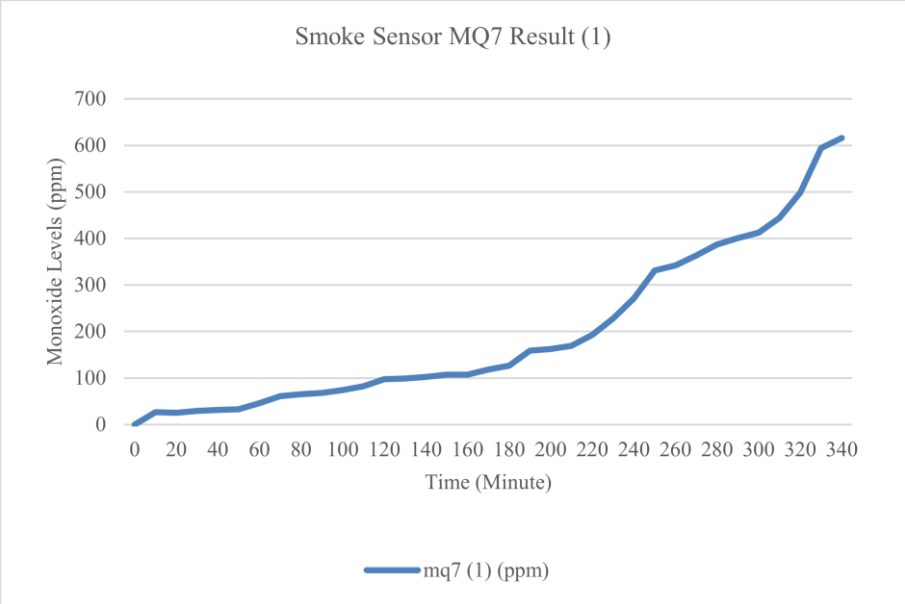

Figure. 3. Smoke Sensor 1 Result chart

Testing of smoke sensor 1 located in the inlet pipe was conducted for 5 hours 30 minutes. The value reading of monoxide gas (ppm) runs gradually and is highly dependent on the amount of charcoal used as fuel. test results are shown in figure 4. Testing of smoke sensor 2 located in the outlet pipe or after passing the filtration process with a length of smoking process for approximately 5 hours and 30 minutes. Sensor 2 serves to compare and determine whether the filtration process is successful or not by comparing the reading results of sensor 1 and sensor 2. The readable monoxide gas (ppm) level is much lower than the reading on sensor 1. test results are shown in figure 4.

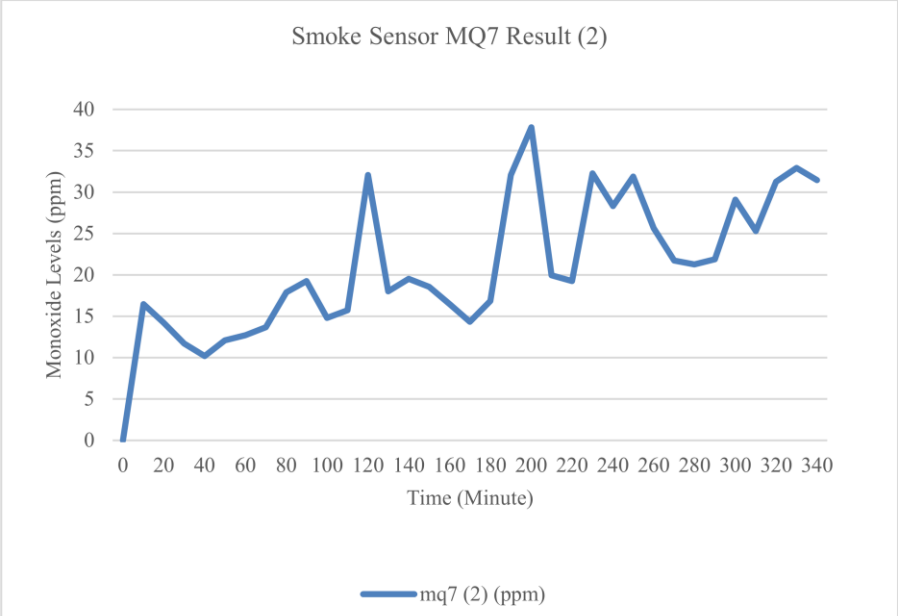

Figure. 4. Smoke Sensor 2 Result chart

The result of reading the level of monoxide gas by sensor 2 when the plant is alive is in accordance with the value of < 101 ppm. The results of the comparison of sensor reading 1 and sensor 2 during the filtration process are as follows.

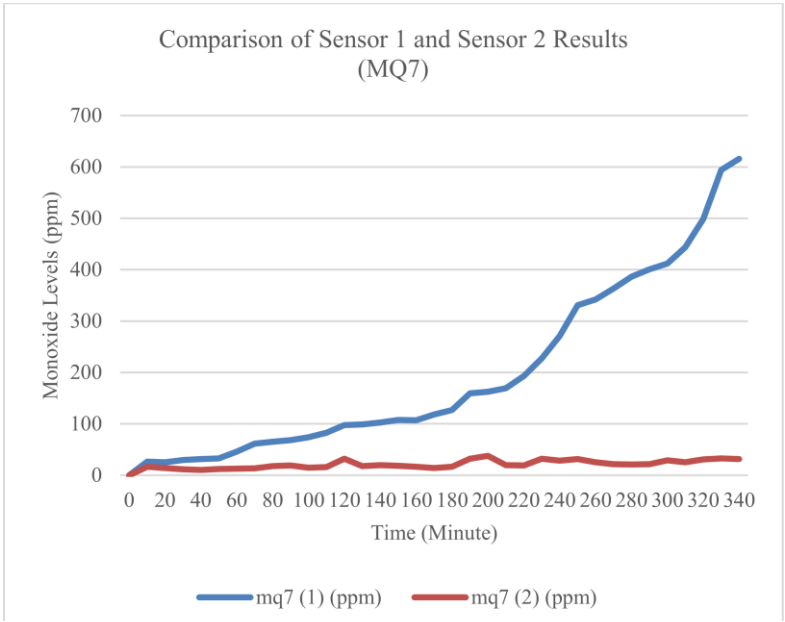

Figure. 5. Comparison of Sensor 1 and Sensor 2 Results

The sensor reading result 1 is higher because when the smoke sensing process is done, the smoke that is stung by sensor 1 has not passed the filtration process and the sensor 2 reading result is lower because the smoke has gone through the filtration process. Percentage reading of the reduction result that aims to determine whether the filtration process is successful or not. There was a decrease in the reduction result at 320 minutes

due to many particles attached to the copper plate, thus disrupting the filtration process. The distance from the process of burning charcoal with filter also affects particles carried by smoke. The longer the distance of burning charcoal with the filter, the less particles will be and the closer the particles carried by smoke will be more and more. Test results as shown in figure 6.

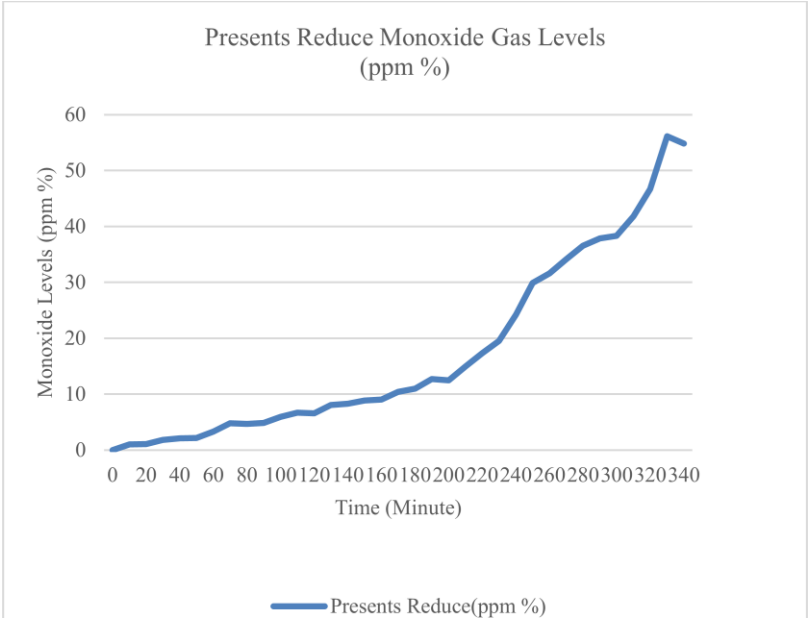

Figure. 6. Percentage Graph of Reduced Smoke Value Measurement

The retrieval of particle results that can be captured by filtration for 330 minutes. The result value can be seen in figure 7.

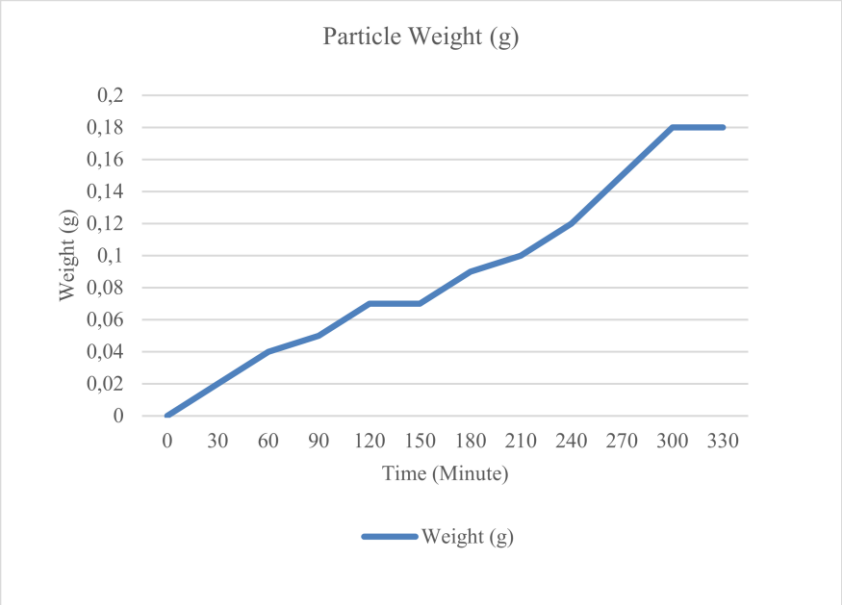

Figure. 7. Particle Weight

4. CONCLUSION

Based on the overall smoke filter system test results. can be inferred in filter system technology using electrostatic method precipitator can be used as a tool to reduce the carbon monoxide gas content contained in the processing process of household industry. Filtration system using copper plate that is supplied by high voltage electricity which later copper plate when supplied with electric current then can absorb smoke and particles. The quality of exhaust carbon monoxide (CO) gas emissions from the processing of this plant is better at about 31.46 ppm than 615.92 ppm (part per million) and can reduce the impact of air pollution

produced by home industry despite the use of copper plates supplied by high voltages. particles contained in smoke are able to filter about 0.18gram within 330 minutes.

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