An Automatic and Realtime Control of Ammonia Concentration in Catfish Pond Water Based on MQ137 Sensor

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Abstract. MQ137 sensor has been successfully used to control ammonia concentration automatically and in realtime in a catfish pond water. The ammonia testing was carried out by bubbling pond water to vaporize ammonia gas to sense by the sensor. The result showed that the could detect the ammonia concentration below 1 ppm and it instructed the water pump to flow the water through a water filter to reduce the ammonia concentration. The application of pond water quality control has resulted in a reduction in the number of catfish deaths due to poisoning.

Key words: MQ137 Ammonia Sensor, Ammonia Concentration, Catfish, Realtime

1. Introduction

Catfish (Claries) is a type of freshwater fish that has been popular and widely cultivated [1,2] and has been used as a source of income by the community. This is because this type of fish is very profitable to be cultivated. Aside from having a high protein content of around 35% it also has an expensive selling price of $770 per metric ton [3,4]. Water quality in catfish cultivation media is an important factor and determines success in catfish cultivation because it acts as an environment where the fish live [5,6].

Ammonia is one of the hazardous chemicals to humans, animals, plants, and the environment [7]. In the cultivation activity, one of the most important media water quality in catfish farming is the Ammonium NH3 content. Ammonia NH3 is one of the compounds that can form in water including catfish cultivation media through several causes. According to Durborow et, al the deposition of food scraps given to fish in a long time led to the formation of NH3 species, besides the results of fish metabolism also contributed to the NH3 content which is quite large [8,9].

Ammonia content is very important to control because at too high a concentration level it can turn into poison in fish. According to Durborow et all 1997, the concentration of ammonia contained in water with a concentration of 0.06 ppm is enough to cause chronic stress and at a higher concentration of 0.6 ppm is very dangerous and enough to cause death in some fish. [10,11].
During this time, the control of Ammonia levels in catfish cultivation media is still done manually and not measured so that it can have a negative effect on catfish. Negative effects caused by uncontrolled ammonia content in catfish cultivation media include slowing of growth, breeding to harvest failure.

With this background in this research, an ammonia level controller that works automatically every time (real-time) by combining the AT 328 microcontroller based AT Mega 328, Ammonia Sensor (MQ137), Relay and Water Pump and monitoring using LCD.

2. Research Object And Working Principle of The Device

The research object developed in the form of a tool made using AT-Mega328 microcontroller with an ammonia sensor to measure ammonia balance and temperature sensor to measure pond water temperature. In addition, to form an ammonia level control system automatically, this device is integrated with a relay and water pump.

As in Figure 1, the two sensors are connected directly to the AT-Mega328 microcontroller as the main controller. The measurement value of the sensor is then inputted and processed using the value of ammonia which is detect by ammonia sensor to determine decision making. The working principle of this tool is when an ammonia sensor that has been placed in a pool detects ammonia levels exceeding the threshold, then the microcontroller will activate the relay to turn on the water pump. The water pump will suck water in the pond and then pump it to the filter, the filter then filters the ammonia and passes the clean water to the pool again.

![Figure 1. Block Diagram of The Tool](image)

3. Result and Discussion

Data calibration of the tool is done by comparing the value of the tool output with the concentration of ammonia made in the test solution at concentrations of 0 ppm, 0.1 ppm, 0.3 ppm, 0.5 ppm, 1 ppm, 2 ppm, 5 ppm, and 10 ppm respectively. The results of the calibration test are shown in table 1 below.
The result in figure 2 shows that the function transfer of tool and concentration ammonia in the test solution is given by $Y = 0.983x - 0.081$, where 0.983, 0.081 and 0.999 is the sensitivity, interception and linearity value respectively. The equation of the transfer function is very important to be obtained and then in the next step, it is used for the instrument calibration equation. The output value of the tool after calibration is shown in the table below.

### Table 1. Data comparison of tool which has calibrated and concentration ammonia in the test solution

| Concentration Ammonia in Test Solution (ppm) | Output Value of Tool (ppm) |
|---------------------------------------------|-----------------------------|
| 0                                           | 0.02                        |
| 0.1                                         | 0.12                        |
| 0.3                                         | 0.30                        |
| 0.5                                         | 0.51                        |
| 1                                           | 1.01                        |
| 2                                           | 2.03                        |
| 5                                           | 5.08                        |
| 10                                          | 10.17                       |

The results of controlling ammonia levels in catfish cultivation media for six days of testing are shown in Figure 3 below.
Figure 3 shows that an increase in daily ammonia concentration in catfish ponds. This can be seen on the first day of cultivation obtained by ammonia concentration in the cultivation medium ± 0.55ppm, whereas, on the third day of cultivation, a very significant increase in ammonia concentration was obtained ± 1.54ppm. The increase in ammonia levels in catfish ponds can be explained by the formation of ammonia in the water media from fish metabolism and the remnants of food submerged in the pond.

The result in figure 2 can also be seen that the ammonia concentration control device in catfish cultivation media has been able to work automatically to keep the ammonia concentration in catfish ponds at an ideal limit, where on the third day of cultivation that is with high ammonia levels ± 1.54ppm which hurts harm to life and breeding of catfish have been successfully controlled and returned to the value of ammonia levels safe for catfish which is ± 0.55ppm. This control process is done automatically, where if the ammonia sensor detects the ammonia concentration of catfish pond water greater than 1.54ppm, the microcontroller will activate the relay and then turn on the water pump to suck water in ponds with high ammonia levels. Furthermore, the water that is sucked by the pump will be forwarded to the filter to reduce the level of ammonia in the water and then, water that has been filtered and has a low ammonia level is returned to the pond again.
4. Conclusion
Ammonia concentration control tool in catfish farming has been successfully tested and applied to catfish culture media in real-time. The test results show that the tool has been able to control the ammonia level of catfish culture water automatically and in real-time. The success of this study is very beneficial for catfish farmers that provide technology to control the ammonia level of catfish water media so that it can improve the quality and quantity of catfish yields.

5. Reference

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