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SIMULATION DESIGN OF ANIMAL WASTE TREATMENT INSTALLATION SYSTEM USING WATER LEVEL CONTROL SYSTEM

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Abstract. The simulation design of this animal waste treatment plant is a design that applies the sewage treatment plant system which is made to cope with environmental pollution, especially rivers due to indiscriminate disposal of animal waste. Making this animal waste treatment plant provides information to readers or the public about how to design an animal waste treatment plant system and the performance of the sewage treatment system so that people know how to deal with environmental pollution caused by the livestock themselves. The manufacture of this installation system uses data collection methods from direct farmers and theories obtained from books, journals, articles related to sewage treatment plant theory, plumbing, electricity, and others. Finally, the data was collected by testing the animal dung waste treatment system where the test data was taken from the pH content of the water used for processing the animal dung waste treatment system. The test results on the sewage treatment plant system concluded that in order to obtain optimal results or water pH content, namely the pH content of 6, it is necessary to deposit animal manure between two to three days, while the maximum processing of this system is the pH content of 6.5. and processing of animal manure, which is on the fourth day to get the maximum pH content.

Keywords: simulation design, animal waste, and level control.

1. INTRODUCTION

Along with the progress of the times and modernization, developments both in the economic field as well as in the field of science and technology are developing very rapidly, coupled with the increasingly rapid flow of information both from within and outside the country, so that the busyness of mankind is increasing. It encourages us as human beings to tend to a practical and efficient lifestyle in all matters of behavior in all fields. For example, in the daily life of residents in rural areas, carrying out activities to maintain several four-legged and two-legged livestock, in maintenance of course the farmers want to raise livestock in a practical way, for example in terms of cage cleanliness, animal waste released by livestock can certainly cause various things. negative, therefore the breeder thinks about how to overcome the negative things caused by the animal waste that is kept by the breeder himself which is commonly called waste [1][2][3].

Waste is organic or inorganic material that is no longer used, so it can cause serious problems for the environment if not handled properly [4][5]. This waste can be in the form of solid, liquid and gas waste which if

not handled properly will have a bad impact on the environment [6]-[8]. Waste originating from the farm will have high economic value if it is treated with the right treatment. There are many ways that can be done to process livestock waste, one of which is processing manure into manure, this method is the simplest way that we often encounter, namely livestock manure is left to dry, by processing the manure it cannot be said to be environmentally friendly, because manure is not environmentally friendly. Livestock processed by drying will cause pollution in the form of gas or odor [9]-[13]. Intervention is needed so as not to damage the environment and work to be more productive [14]-[15].

Research conducted on the processing of livestock manure which is currently an issue as one of the causes of global warming, therefore it is necessary to introduce livestock waste processing technology to the wider community. This prompted the intention to learn about animal waste treatment using existing technology, by means of an automatic system for cleaning animal waste in cages.

The limitations of the problems in the design of the pig manure waste treatment installation system are as follows: (a) Design of an automation system for treating pig manure, (b) In designing an animal dung waste treatment installation system in the manufacture of a miniature simulation of its installation using a water level control system that drives an electric motor, and a submersible pump, blower or aerator turns on automatically through a water level control switch, (c)The calculation uses real data from farmers in the design of this system, while the simulation of the design of the installation system is a mock-up or a small-scale imitation of the original system, (d) The tests carried out are only testing the pH of the water removed from the system treatment process.

The objectives of our research are as (a) to find out how to design a simulation of an animal dung sewage treatment plant system using a water level control system, (b) to find out how the animal waste treatment plant system works using a water level control system. Based on these objectives, the expected benefits of the research results are: (a) reducing disturbances that can occur during the distribution of animal waste disposal channels so as to prevent damage to the surrounding environment, (b) from a scientific point of view, the results of this study are expected to be useful and contribute to the development of knowledge, especially in the problem of animal waste treatment systems, which are related to environmental influences on farmers.

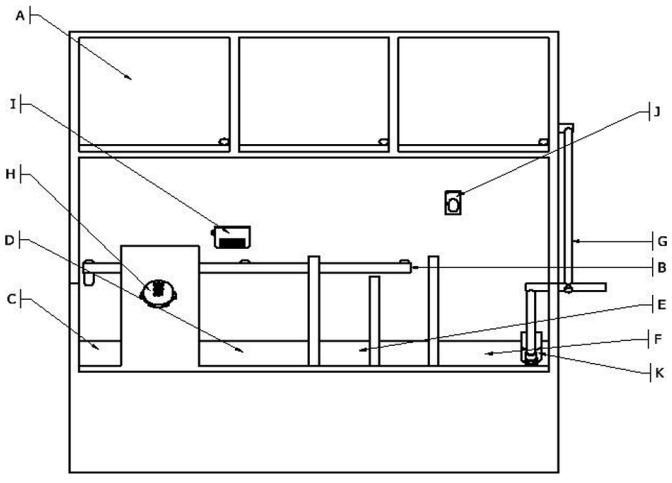
2. METHODS

2.1 Research Procedure

In this type of research, it is divided into two options, namely study or case analysis and testing, and also design. From the choices above, the author chooses the design method because the author will design a sewage treatment system using a water level control system assisted by an electric motor, a blower and a submersible pump. The size of the simulation to be made is 100 cm long, 50 cm wide and 50 cm high overall (Figure 1).

2.2 Design Model

The design model is as follows.



Descriptions:

A. Cage	H. Dynamo
B. Cage Drain	I. Aerator
C. Extractor Tub	J. Water level control
D. Aerator Tub	K. submersible Pump
E. Filter Tub	
F. Chopsticks Tub	

Figure 1. Animal waste treatment system simulation

2.3 Research Instrument

In this design, instruments or tools are needed that support the data collection process from material preparation to obtaining data. The instruments needed are: meter, animal dung, and measuring pH.

2.4 Research Procedure

The stages that will be carried out by the author to get the results of the targeted design are as follows:

1. Conducting literature studies and field surveys, interviews with residents around the river and direct farmers so that they get the data needed in this design.
2. Processing the data obtained so that we get the data that will be used in the design of the animal dung treatment plant system.
3. After that we design in terms of tools or materials, design and layout of the installation needed in designing the system.
4. After that we began to collect the materials needed and started assembling according to the design that has been made.
5. After the mock-up is completed, we start the calculation starting from determining the use of an electric motor that matches the size to be used, as well as blowers and submersible pumps.
6. Then we test the treated water so that it can be said to be clean using the elements obtained

3. RESULTS AND DISCUSSION

3.1 Design Results

This simulation design is designed and made to overcome the problem of river environmental pollution by processing it using the sewage treatment plant method. This simulation design has dimensions of 50 cm high, 50 cm wide and 100 cm long, using a water level control system, electric motor and submersible pump (Figure 2.).

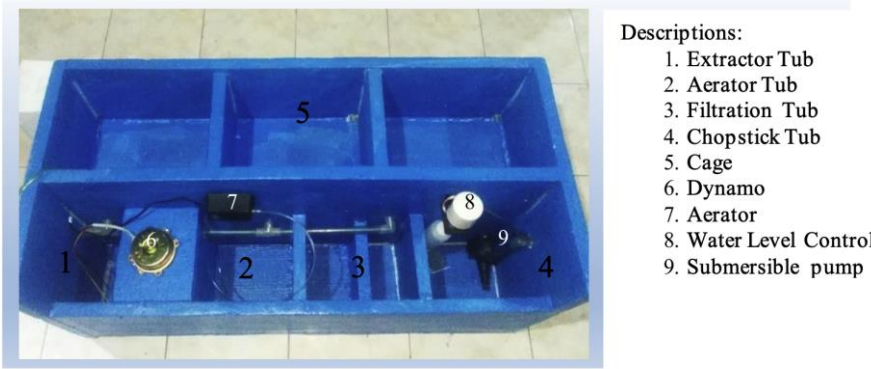


Figure 2. Animal waste treatment system simulation

1. Design Working Principle

The simulation of this animal waste treatment system uses a water level control system that plays a role in the process of processing manure and water. In the design process of the simulation of the animal waste treatment system, the operation is determined by the water level control which is based on the volume of water installed in the chopstick tub, if the tub has reached the full point, the water level control which is an automatic switch will automatically turn on the system then after the volume of water in the sump is reduced, the system will automatically turn off, only the aerator continues to be turned on. This aims to control or can be said to be a safety cost if this simulation is implemented in real time (Figure 2).

2. Design Specification.

a. High total	: 50 cm	f. Cage Length	: 30 cm
b. Width	: 50 cm	g.Tub Height	: 26 cm
c. Length	: 100 cm	h.Tub Width	: 19 cm
d. Cage Height: 23 cm	i. Tub Length	: 23 cm	
e. Cage Width	: 22 cm		

Volume : 30 x 22 x 23 = 15,18 cm^3, 15,18 x 3 Cage = 45,54 cm^3, 45,54 cm^3 : 4 = 11,380 cm^3

So the volume of each tub = 11,380 cm^3

3.2 Discussions

Making a simulation design for processing animal dung is obtained by performing various calculations and tests in accordance with the existing formula.

1. Selection of Materials for Making Simulation Cages and Tubs

The material used in making the simulation of the cage and the tub in the simulation design of the animal waste treatment system is styrofoam with 2 meters length, 1 meter width and 5 cm thickness per styrofoam, the purpose of choosing styrofoam for the simulation of the cage and the tub is to save energy. cost and easy to use in the sense that it is easy to shape according to the series of cages and tubs that we have designed and also styrofoam is water resistant if used correctly. Making this simulation using 3 sheets of Styrofoam.

2. Calculation of Electric Motors, Blowers and Submersible Pumps

The calculation of the minimum power of the dynamo or electric motor to be used is calculated through the volume of the tub used. The tub used has a length of 23 cm, a width of 19 cm, and a height of 26 cm using the formula W x W x H and these numbers have been converted to meters to get a volume of 11.362 liters per tub.

a. Calculation of the power of electric motors, blowers, and submersible pumps
   Q = V/t
b. Power supply calculation
   P = V . I . Cos Ø
c. MCB Current Limiter Determination
   l am = $\frac{Pth}{cos\emptyset}$

3. Plumbing Design

The plumbing design in the simulation of the animal waste treatment plant system uses a water level control system and uses a pipe with a pipe diameter of 16 mm. The plumbing installation in this simulation is divided into three, namely the inlet pipe for sewage into the extractor tank, then the pipe from the submersible pump out branches into two, one is the return channel to the cage, the other is the drainage channel which can later be used again or disposed of.

4. Electrical Installation Design

The design of the electrical installation in this simulation of the animal waste treatment system uses water level control as a switch to turn on the electric motor and submersible pump, for the aerator will continue to run because it does not go through water level control, it only passes through the MCB. The cable used in the simulation of the animal dung waste treatment system installation is an NYY cable with a cable cross-section of 0.75 mm2 with a current carrying capacity of 12 amperes (Figure 2).

5. Material Preparation

Descriptions:
1. MCB
2. Water level control
3. Submersible pump
4. Electric Motor

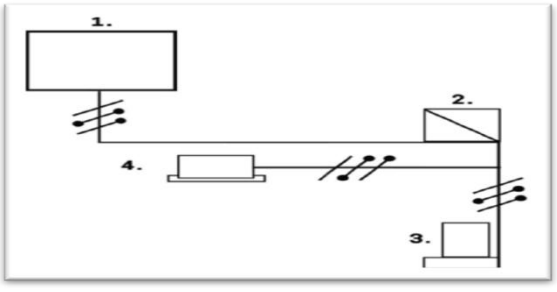


Figure 2. Water level control installation

To expedite the process of making a simulation design for this animal dung waste treatment installation system, it is necessary to prepare the materials to be used that have gone through previous calculations. The following are the materials that are prepared to make a design such as Table 1:

Table 1. Materials

No	Materials	Total
1	Styrofoam 5 cm thick, 2 m length, 1 m width	3 piece
2	Transparent pipe diameter 16 mm, length 2 m	2 piece
3	Dynamo 220V Frequency 50Hz	1 piece
4	Aerator 220 – 240V, Rate 3 L/Min	1 piece
5	Water level control	1 piece
6	submersible pump *output 1*500 L/H	1 piece
7	MCB and MCB boxes 1 ampere	1 piece
8	NYY Cable Cross Section 0,75 mm^2	4 meter
9	Stop valve/faucet	1 piece
10	Electrical Insulation	1 piece
11	Styrofoam and pipe glue	1 piece
12	Waterproof paint	1 kg
13	sealants	1 piece
14	T pipe connection	5 piece
15	L pipe connection	4 piece

6. Cage Simulation Making

[1] Prepare tools, namely: hacksaw, tape measure, marker, brush

[2] Prepare the materials as follows:

a. Styrofoam c. sealants

b. Styrofoam glued. Waterproof paint

[3] Making process

a. Make 1 piece of Styrofoam with 90 cm length and 50 cm width for the back.
b. Make 2 pieces of Styrofoam with a length of 50 cm and a width of 50 cm for the sides.
c. Then unite it using Styrofoam glue.
d. Make the cage by cutting 2 pieces of Styrofoam measuring 23 cm long, 22 cm wide for the sides, and 3pieces of Styrofoam measuring 30 cm long, 22 cm wide for the bottom of the cage.
e. Then make the front of the cage with a length of 90 cm and a width of 50 cm 1 piece.
f. After that unite using Styrofoam glue.
g. Cut the Styrofoam with a length of 26 cm and a width of 19 cm as many as 3 pieces for the tub and 1 piecemeasuring 20 cm long and 19 cm wide for the filter tub.
h. Unite using Styrofoam glue to the front of the Styrofoam cage.
i. Then make 1 piece of Styrofoam with a length of 90 cm and a width of 30 cm for the very front and thenstick it to the front of the tub.
j. After everything is put together, then sealant every corner to avoid leakage and provide holes in each tub for pipelines and holes for electrical cable lines. After that, then paint all parts using waterproof paint.

7. Installation of Plumbing and Main Components

1. Prepare materials and tools such as pipes and their connections, pipe glue, saws, meters, electric motors, aerators or blowers, water level control, submersible pumps, cables and electrical insulation, and MCB and MCB boxes, screws, and screwdrivers.

2. Making Process

a. Cut the pipe as many as 3 pieces with a length of 20 cm, then install it on the simulation tub with 2 L connections and 3 T connections to the extractor tub.

b. Then install the components starting from the electric motor or dynamo, aerator, water level control, and submersible pump as shown in Figure 3.

Figure 3. Main Components

c. After the main components are installed, install the pipe on the submersible pump as a two-pronged outlet, one return channel to the cage and one channel to exit through the faucet later.
d. Then install the MCB and MCB boxes on the left side of the cage, then assemble the electricity starting from assembling the power cable through the MCB and then connecting to the water level control which will be forwarded to the dynamo and pump.
e. Then the aerator will get a direct power supply without going through the water level control. For the neutral cable on each component is connected and mounted on the MCB box.
f. Put the plug on the power cable from the MCB which will be used to get AC from PLN.

8. Finishing Process
   1. Preparing materials for the finishing process, namely electrical insulation, sealants, cable ties, and waterproof paint.
   2. Finishing process
      a. Tidy up the cables using electrical insulation and cable ties.
      b. Sealant on the corners once again to avoid leakage in the system.
      c. Paint the inside of the system once again using waterproof paint.
9. Testing Process
   Testing the simulation design of the animal dung sewage treatment plant system is carried out by measuring the pH content of the treated water and testing is carried out based on time, alum pouring, water volume, and pH content. The test was carried out for 5 days to get the maximum water pH test results in this animal waste treatment system. The testing process is based on time, starting from the pouring of alum, the volume of water, and the deposition of dirt to the processing in which the water coming out of the filtration tank is measured for its pH content.
10. Test Result Data
    Testing the simulation design of the animal dung waste treatment installation system was carried out in the Ubung Kaja area, North Denpasar, Denpasar. In this testing process, data were collected 5 times in 5 days for the results of measuring the pH content of the water (Table 3.2)

Table 3.2 Testing the pH of the water

Deposition Time	Process Time	Water and Waste Volume	Alum Level	pH Content
1 day	10 mins	45.49 liter	45 gram	5.78
2 days	10 mins	45.49 liter	45 gram	5.93
3 days	10 mins	45.49 liter	45 gram	6.20
4 days	10 menit	45.49 liter	45 gram	6.41
5 days	10 menit	45.49 liter	45 gram	6.68

11. Desired pH content in the range of 5.5 to 6.5

From the test results data in table 3.2, the simulation design of the animal waste treatment system where the pH content curve of the water shows that the duration of deposition of the sewage effluent affects the pH content of the water in the treated sewage treatment. The following statistics illustrate the effect of the duration of deposition on the pH content of the treated water as shown in Figure 4.

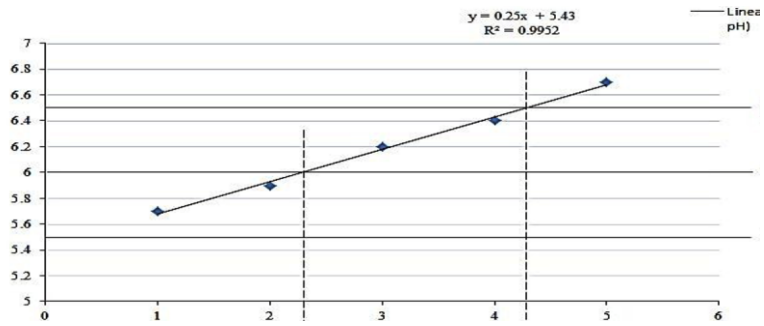


Figure 4. Linear statistics of water pH content

From the statistical picture above, it can be seen that the duration of deposition of animal dung waste affects the increase in the pH content of the water significantly, as seen in the statistics of the optimal value or the optimal pH content of the targeted water, which is at pH 6, where the optimal value point is between the second and third days. it shows that between the second and third days, the duration of deposition is the right day to get optimal water pH results while for the maximum value or maximum pH content, it is on the fourth and fifth day which indicates the maximum duration of dirt deposition in the range of four days to get the optimal pH content. desired is between 5.5 to 6.5.

4. CONCLUSION

Based on the results of the simulation design of the animal dung treatment plant system, it can be concluded:

a. Design and build a simulation of the Animal Manure Waste Treatment System using styrofoam with a thickness of 5 cm as the main material in making the simulation. This design has specifications, namely a total height of 50 cm, a width of 50 cm, and a length of 100 cm. Then for the height of cage 23, the width of the cage is 22 cm, and the length of the cage is 30 cm per tub. The tub has a height of 26 cm, a width of 19 cm, and a length of 23 cm per tub. This design in the processing process is based on the volume of water that will connect the switch to the water level control which will turn on the system and use a filter in the form of wood charcoal and alum as a filter and water purifier.
b. In the test results, it was found that in the simulation design of the animal dung waste treatment system, the duration of the deposition of waste is a factor that affects the pH content of the treated water, obtained for the optimal value or optimal pH content, namely pH 6 is in the deposition between the second and third days, while for the maximum value is on the fourth day to get the pH according to the target.

With the development of the era and technology in the world of mechanical engineering, more knowledge about technology in education is developed, especially in the field of mechanical engineering. In the design of the simulation system for the animal waste treatment plant, there are still many shortcomings, we hope that in the future someone will analyze and develop more deeply this system, and it is recommended that when processing waste, cleaning the filter is always done.

5. REFERENCES

[1] Adrian, K.2020. Ketahui Klorin. Avaliable on: https://www.alodokter.com/ketahui-fungsi-dan-bahaya-klorin. Accesed on November 25, 2022
[2] Amsari, I. 2019. Analisa Unjuk Kerja Pompa Submersibel. Skripsi. Universitas Sumatra Utara
[3] Builder Indonesia. 2018. Dinamo listrik dan bagian-bagiannya. Avaliable on: https://www.builder.id/dinamo-listrik- dan-bagiannya. Accesed on October 02, 2022
[4] Church, Austin HC, Z. Harahap. 1998. Pompa dan Blower Centrifugal. Erlangga. Jakarta
[5] Edahwati, Luluk. 2014. Kombinasi Proses Aerasi, Adsorpsi, dan Filtrasi pada Pengolahan Air Limbah Industri Perikanan. Scientific Journal of Environmental Chemical Engineering Study Program Faculty of Industrial Technology UPN Veteran East Jawa
[6] Frengky, Suryani, Reni. 2015. Pengaruh Perbedaan pH Terhadap Pertumbuhan dan Hasil Tanaman Kailan. Scientific Journal Respati Pertanian Vol. 7.
[7] Gumilar, G. 2011. Perencanaan Plumbing Air Bersih Dan Air Kotor. Yudhistira. Surakarta
[8] Hidayat Nur. 2011. Autodesk Inventor. Mastering 3D Mechanical Design. Bandung: Informatika
[9] Hadiyono, Yatin, 2015. “Gambar Teknik”. Learning Module Inventor Autodesk. 4.
[10].Hidayat, F.2019. Mengenal Submersible Pump. Avaliable on: https://www.fachrulhyd.com/2019/09/mengenal- submersible-pump- html. Accesed on December 01, 2022
[11] Qasim, S. R. 1990. Wastewater Treatment Plant. Sage publication. New York Suhartana. 2006. Pemanfaatan Tempurung Kelapa sebagai Bahan Baku Arang Aktif dan Aplikasinya untuk Penjernihan Air Sumur. Physics Periodic Journal . Vol 9:3
[12].Taharica Group. 2020. Pengertian Dasar Water Level Control. Avaliable on: https://www.loggerindo.com/pengertian dasar-water-level-control-dan- kelebihannya-351. Accesed on Januari 03, 2022
[13] Santosa, I. G., & Yusuf, M. (2017). The application of a dryer solar energy hybrid to decrease workload and increase dodol production in Bali. International Research Journal of Engineering, IT & Scientific Research, 3(6), 99–106.

[14] Rajendra, I. M. ., Yusuf, M. ., & Sugiartha , N. . (2020). Effect of substrate size and stirring on the effectiveness of fermentation of organic waste using composter cash. International Research Journal of Engineering, IT & Scientific Research, 6(6), 10–20.

[15] Yusuf, M. 2014. Design of Jewel Stone Sharpener to Increase Jewel Worker Work Productivity in Bali. Proceedings of the International Conference on Engineering Technology and Industrial Application. Surakarta. ISSN 2407-4330.