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DESIGN AND BUILD AN AUTOMATIC TRASH RAKE TOOL IN FOR RIVER USING A CHAIN CONVEYOR

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Abstract

Conveyor is a mechanical system that has the function of moving goods from one place to another. Conveyor is one of the many types of transportation used in the industrial world today. The aim of this research is to create a tool conveyor, which can help the community overcome problems in terms of handling waste in waterways and cleaning up floating rubbish in river basins, ditches and other waterways.This research uses research methodsand development with a quantitative approach. The results of making an automatic trash rake tool in the river using chain conveyor designed only one step of system work conveyor and the trash rake has a length of 1000 mm, width 500 mm, height 300 mm with a frame made of iron hollow. The power and power needed to rotate the tool is 216 watts ~ 0.216 Kw with a horsepower of 0.3 HP from a motor dynamo engine gearbox an AC type motor with a power of 0.37 Kw was selected; Power 0.5 HP. The linear speed of the chain every second can move as far as 0.12 m/s or 120 mm/s. The load acting on the chain has a waste carrying capacity of 1020 kg/hour or 0.28 kg/s with a tool effectiveness value of 99%. So this tool is working effectively.

Keywords: *Conveyor, trash rake, river.*

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Introduction

Waste is a material that is discarded or discarded from sources of human activity or natural processes. Waste is classified into two types, namely easily decomposable and difficult to decompose. This difficult to decompose waste has the potential to cause soil and water pollution, which of course can also cause health problems for the surrounding environment in the long term. If the river is full of rubbish, the water cannot flow smoothly. Not only is rubbish easily thrown into rivers, household rubbish and other rubbish are also often just thrown into rivers, ditches and irrigation. This can create sedimentation in water channels, resulting in shallowing of the river. This can cause polemics, one of which is flooding and can also cause various diseases so serious attention is needed to clean it up.

Looking from this side, tools or machines are like conveyor can be implemented in water channels as a trash rake machine that can work continuously and has no operating hours limits.Conveyor It has been widely used in the industrial world and it cannot be denied that several industries use it conveyor as a primary need. This can also be implemented, especially in ditches, irrigation and rivers, by transporting rubbish that is blocked in water channels and then moving it to the place provided so that blockages do not occur.One solution to overcome the problem of rubbish in rivers is to make a conveyor tool to automatically rake rubbish in rivers. This tool will later work to transport rubbish floating on the surface of the river and then move it into the rubbish bins that have been provided. This tool is installed at the river sluice gate which uses a trash rake that floats on the equipped water surface chain conveyor as a garbage carrier to the place that has been prepared.

Based on the background of this problem, the author is interested in creating a tool that can help overcome problems in terms of handling waste in waterways, with this the author took the title

"Design of an Automatic Garbage Racking Tool in Rivers UsingChain Conveyor" to overcome the problem of waste in waterways.

Chain conveyor

conveyor is a mechanical system that has the function of moving goods from one place to another. Conveyor comes from the word "convoy" which means walking together in a large group.Conveyor widely used by industry to transport large quantities of goods to save time in covering transportation distances as well as saving human energy and being sustainable. Under certain conditions conveyor widely used but must have a fixed location so that the conveyor system has economic value compared to heavy transportation such as trucks and transport cars. The weakness of this system is that it does not have flexibility when the location of the goods being mobilized is not fixed.

Chain conveyors are one of the many types of transport equipment used in the industrial world today.Chain Conveyor functions to move material from one place to another. The main component of this tool consists of a chain where this chain is connected to a rake to move materials, adjusted to the material to be transported. This chain is driven by sprocket which is connected to an electric motor whose rotation is reduced by reduction gear (reduction gear).

Gears/Gearbox

A gearbox is a special device needed to adjust the power or torque (moment/force) of a rotating motor. The gearbox is also a tool that converts power from a rotating motor into greater power by combining mechanical and electrical devices. In principle, the difference between a motor dynamo (electric motor) and a gearbox is:

1. *Motor dynamos have high speeds but low loads (small torque).*
2. *The gearbox has a low speed but is capable of carrying heavy loads (large torque).*

The gearbox, in cases related to the field of machinery needs, has the function of transferring power from the driving force (diesel engine or electric motor dynamo) to the machine that is to be driven. There are at least 2 key reasons why the use of Gearboxes in the world of machinery plays an important role, firstly, the main function of the Gearbox is to slow down the rotation speed resulting from the rotation of the motor dynamo or diesel engine and the second is to strengthen the rotational power produced by the dynamo or diesel. Slowing down applications is one of the main functions of Gearbox and that is why Gearbox is also often referred to as "Speed Reducer". Apart from being "Speed Reducer"Another function of the gearbox, especially in industrial purposes such as factories, mining, fisheries, and others, is to strengthen the power of electric motors. Along with the main function of the gearbox as reducing speed, the gearbox also automatically functions to strengthen the torque from the dynamo or diesel. Without the support of an appropriate gearbox, a motor dynamo or diesel engine will have difficulty lifting heavy objects, if forced, it can speed up the life of the motor dynamo or even damage the motor. The speed of the motor issued on a motor gearbox determined in the following equation:

$$N = \frac{Nm}{R} \qquad (1)$$

Where :

N = Speed (Rpm)

Nm = Speed Motor (Rpm)

R = RatioGearbox

To find out the angular speed of the machine conveyor You can use the equation below:

$$\omega = N.\frac{2\,p}{T} \qquad (2)$$

Where :

ω *= Omega (Radian/s)*

N = Speed (Rpm)

$2\,p$ *= 2 x 3.14*

T = Time (Second) = 60 seconds

To find out the power/power needed to rotate chain conveyor on the motor bike gearbox through the following equation:

$$P = \frac{\Delta Ep}{\Delta t} = m.g\frac{\Delta z}{\Delta t}/\eta\, Gear\ Box\ .\ \eta\, Transmission\ .Sf \qquad (3)$$

Where :

m	:	*Total tool weight (Kg)*
g	:	*Gravity (9.8 m/s²)*
Δz	:	*Center distance (m)*
Δt	:	Δz / *V*
IN	:	*Speed (m/s)*
the	:	*Efficiency*
Sf	:	*Safety Factor*

To find the output power of a motor gearbox using the efficiency formula, the calculation is carried out using the following formula:

$$h = \frac{Power\ output}{Power\ input}x100 \qquad (4)$$

Meanwhile, to determine the output torque of the gearbox motor used in the automatic trash rake in the river, use the following equation:

$$T = \frac{P}{2p.n} \qquad (5)$$

Couples

The shaft is one of the most important parts of every machine. Almost all engines transmit power along with rotation. The main role in the transmission is played by the shaft. The shaft is used to transmit power. If P is the nominal output power of the drive motor, then various safety factors can usually be taken into account in the design, so that the first correction can be taken to be small. If the correction factor is f_c *then plan power* P_d *(kW) as a benchmark is*

$$P_d = P\ fc\ (kW) \qquad (6)$$

***Table 3**. Correction factors for the power to be transmitted,fc*

Power to be transmitted	*fc*
Average force required	*1,2 - 2,0*
Maximum force required	*0,8 - 1,2*
Normal power	*1,0 - 1,5*

Roller Chain Transmission

The roller chain is a machine element that functions to transmit power or rotation from the driving machine. Power transmission chains are usually used where the shaft distance is greater than in a gear transmission but shorter than in a belt transmission. The chain hooks onto the teeth sprocket and transmits power without slipping, thus ensuring a constant rotation ratio. Single chain chains are the most widely used. Multiple circuits such as two or three circuits are used for heavy load transmission. The formula for finding the linear speed of the chain on drive sprocket using the equation below:

$$V = \omega . R \qquad (7)$$

V = Speed (m/s)

ω =Omega, (radians/s)

R= Turning radius (m)

The load acting on the chain conveyor automatic waste rake tool F (kg) can be calculated using the formula:

$$F = \frac{102p_d}{in} \qquad (8)$$

F = maximum load/weight (kg)

P_d = design power (Kw)

v = chain speed (m/s)

To determine the effectiveness of the automatic waste rake process, the following formula is used:

$$Effectiveness = \frac{F - mass\ of\ waste}{F}\ x100 \qquad (9)$$

Research methods

This research method uses research and development methods with a quantitative approach resulting from analyzing a design toolconveyor. The samples used were loads of rubbish floating on the surface of the water and a power source from a motorbike gearbox.

Time and place

In compiling the Final Project and designing the tools, this is done on site, namely:

1. *The tools are made in the workshop*
2. *While compiling the final assignment report, this was done at home and in the workshop.*

Tools and materials

1. *Tool*

The tools used to design the tools in this research are:

a. *Lathe machine for making shafts sprocket.*
b. *Machine milling to make a spi, and make a hole in the plate*
c. *Grinder (hand and sitting) to cut material and flatten the cutting surface.*
d. *Angled ruler*
e. *Ruler/meter to measure the length of material*
f. *Vernier calipers/vernier caliper/sigmat*
g. *Wrench 27/wrench*
h. *Electrode welding machines are used for welding frames, waste holders and rakes*
i. *Siku las*
j. *Iron chalk*
k. *Tang*
l. *Hammer*
m. *L key*
n. *Spray gun*

2. *Material*

a. *Hollow iron*
    1) *40x40x6000mm Tebal 1.4mm = 2 btg*
    2) *40x40x6000mm Thickness 1.8mm = 1 stem*
b. *Iron plate*
    1) *10x40x300mm = 8 pc*
    2) *12x20x300mm = 4 pc*
    3) *6x100x300mm = 2 pc*
c. *Strip plate iron 5x30x2m = 8 rods*

d. *Mesin dynamo gearbox 0.37kw,380v, 0.5hp. 3 phase*
e. *Base as/shaft∅25x800mm is used for the shaft*
f. *Iron elbow*
g. *Rantai Rs 60x3m = 2 roll*
h. *Sprocket Rs 60*
    1) *4inc = 5 pc*
    2) *3inc = 1 pc*
i. *Snap ring*
j. *Bearing 4pc*
k. *Pillow blok take up units 2pc*
l. *M18 nuts and bolts*
m. *2pcs threaded iron*
n. *Planting bolt*
o. *Cat*

Research procedure

The procedural steps for research activities are as follows:

a. *Study literature*

   The first step in the research procedure is to study scientific books and articles on the internet with matters related to research.

b. *Design tool images*

   The second step is designing/designing a drawing of the tool as an initial description of the tool to be made.

c. *Preparation of tools and materials*

   The third step is to prepare the tools and materials that will be used to make the tools.

d. *Making/assembling tools*

   The fourth step, after preparing the tools and materials has been completed, continues with the process of making tools/assembling tools.

e. *Tool testing*

   The fifth step is to test the finished tool to determine damage and errors during the tool construction process.

f. *Data retrieval*

The sixth step is that the tool has been tested and then collects data to prove that the trash rake tool in the river can function properly.

g. *Analysis of tool capabilities*

The seventh step, after collecting data from testing, is then analyzing the tool's capabilities to find out the limits of the tool's capabilities for raking rubbish in the river. An analysis is needed so that the actual capabilities of the tool can be compared with an analysis of the tool's capabilities using calculations.

Flow diagram/flowchart Study

In this research, the research steps refer to the flow diagram

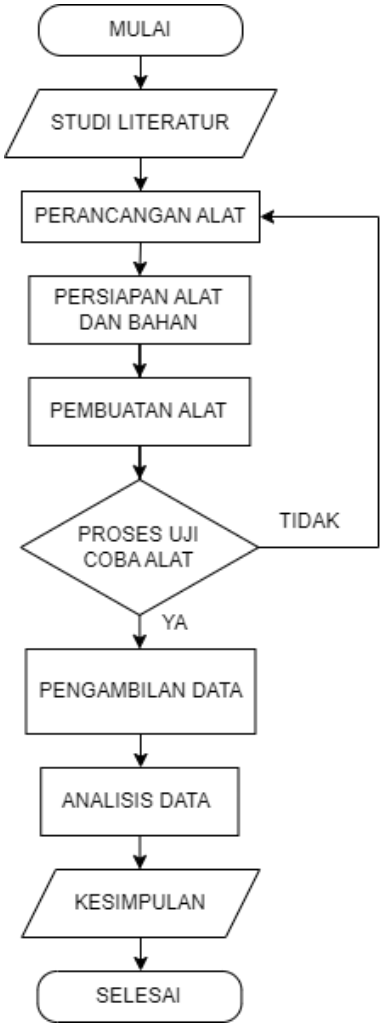

Figure 1. *research flow diagram*

Research results and discussion

This research is entitled design of an automatic waste rake tool for using riverschain conveyor is a model of a trash rake in waterways with the aim of helping people clean up trash floating in river basins, ditches and other waterways without having to use trash cleaning services.

Figure 2. *The results of making an automatic trash rake tool in the river usingchain conveyor.*

The trash rake tool in the river is designed with just one step in the system conveyor for more simple and more efficient. The trash rake tool is placed in a slanted position. The clogged waste will be filtered using a rake and then the waste will be carried to the top using a carrying machine/chain conveyor Then the rubbish will fall into the rubbish bin that has been provided behind the rubbish rake frame.

Tool Calculation

1. *The results of calculating the speed of the motor that is released at a time gearbox using equation (1) below:*

$$N = \frac{Nm}{R}$$

$$N = \frac{1370}{60}$$

$$N = 22.8 \sim 23.3\ Rpm$$

2. *Results of angular velocity calculations on the trash rake system conveyor using equation (2) as follows:*

$$\omega = N\ x\ \frac{2\ p}{T}$$

$$= 23{,}3\ x\ \frac{2x3{,}14}{60}$$

$$= 23{,}3\ x\ \frac{6{,}28}{60}$$

$$= 23{,}3\ x\ 0{,}1046$$

$= 2{,}44\ Radians/second$

3. *The results of calculating the linear speed of the chain on drive sprocket obtained from size sprocket which is divided into two using equation (7) below:*

$V = \omega\ x\ R$

$R = 4\ x\ 25{,}4$

$= \frac{102}{2}$

$= \frac{51}{1000}$

$= 0{,}051\ m$

$V = 2{,}44\ x\ 0{,}051$

$= 0{,}12\ m/s$

4. *Results of calculating the power/power required by the motor gearbox to rotate the automatic trash rake in the river using chain conveyor using equation (3) below:*

$$P = \frac{\Delta Ep}{\Delta t} = m.g\frac{\Delta z}{\Delta t}/\eta\ Gear\ Box\ .\ \eta\ Transmission\ .Sf$$

Is known :

1. *ΔEp*
2. *Tool mass: 50 kg (estimated)*
3. *Chain weight: 2.4 kg x 2 = 4.8 kg*
4. *Weight of 1 set of rakes : 2.8 kg : 4 = 0.7 kg*
5. $\eta\ Gearbox\ efficiency$: 0.6
6. $\eta\ Transmission\ efficiency$: 0.8
7. *Gravity g: 9.8 m/s^2*
8. *Distan cecenter sprocket up and down,Δz : 980 mm*
9. *Safety factor sf : 1.5 (selected)*

Answer:

M = 50 + 4,8 + 2,8

= 57,6 kg

$\Delta t = (\frac{\Delta z}{1000})/IN$

$= \frac{980}{1000}$

$$= \frac{0,98}{0,12}$$

$$= 8,17 \sim 8\ m/s$$

$$\Delta Ep = m\ x\ g\ x \frac{\Delta z}{\Delta t}$$

$$= 57,6\ x\ 9,8\ x \frac{980\ mm}{8\ m/s}$$

$$= \frac{553190}{8}$$

$$= \frac{69149}{1000}$$

$$= 69,149 \sim 69\ m/s^2$$

$$(\Delta Ep/(\eta\ Gear\ Box\ .\ \eta\ Transmission\ )).Sf$$

$$= (69/(0,6\ x\ 0,8))\ x\ 1,5$$

$$= \left(\frac{69}{0,48}\right)\ x\ 1,5$$

$$= 144\ x\ 1,5$$

$$= 216\ watt$$

$$= \frac{216}{745,7}$$

$$= 0,289 \sim 0,3\ hp$$

5. *Results of calculating the output power of a motor gearbox using equation (4) below:*

$$h = \frac{Power\ output}{Power\ input} x100$$

$$1,4 = \frac{After}{370} x100$$

$$After = \frac{1,4}{100} x370\ \ watt$$

$$= 5,18\ watt$$

6. *Meanwhile, the results of calculating the output torque from the gearbox motor used in the automatic trash rake in the river using equation (5) are as follows:*

$$T = \frac{P}{2p.n}$$

$$Torque\ output = \frac{5,18}{2\pi x(\frac{1370}{60})}$$

$$= \frac{5,18}{(6,28x22,8)}$$

$$= 0{,}036\ Nm$$

7. *Results of calculating the load acting on the chain conveyor automatic waste rake tool F (kg) can be calculated using equations (6) & (8) below:*

$$Pd = P\ x\ fc$$

$$= 0.37\ Kw\ x\ 1.5$$

$$= 0{,}555\ \textit{Kw} \sim \textit{0.6 Kw}$$

$$F = \frac{102.Pd}{IN}$$

$$= \frac{102\ x\ 0{,}6}{0{,}12}$$

$$= 510\ Kg$$

8. *The automatic trash rake tool in the river uses 2 chains, so the load acting on the chains is as follows:*

$$= 510\ x\ 2 = 1020\ kg/jam$$

9. *The results of calculating the effectiveness of the automatic waste rake using Equation (9) are as follows:*

$$Effectiveness = \frac{F - m(trash)}{F}\ x100$$

$$= \frac{1020\ kg - 1{,}6\ kg}{1020\ kg} x100$$

$$= 99\ \%$$

Calculation Discussion

After obtaining the calculation data above, it can be seen that the energy and energy required to rotate the automatic waste rake is 216 watts ~ 0.216 Kw with a horse power of 0.3 HP; So the specifications for the driving motor on the market were chosen to exceed the required power, namely an AC type motor with a power of 0.37 Kw; Power 0.5 HP with rotation speed 23.3 rpm/minute. Because the dynamo has been reduced with a 60 ratio gearbox, it can rotate slowly so that the waste doesn't bounce far back. With the power and power of the dynamo gearbox, the linear speed of the chain can move 0.12 m/s or 120 mm/s every second. The load acting on the chain has a waste carrying capacity of 1020 kg/hour or 0.28 kg/s so it has a tool effectiveness value of 99%. This is because all types of rubbish floating on the surface of the water can be lifted by the rake. So this trash rake tool is working effectively.

Conclusion

From the research that has been carried out, the conclusions that can be drawn from this research are:

a. *A design for an automatic waste rake tool for rivers has been completed to help communities around river water flows, ditches and irrigation in terms of handling waste which causes flooding polemics every year.*

b. *The trash rake tool in the river is a tool that works to transport trash floating on the surface of the river water and then move it to the trash storage area that has been provided. This tool is installed on a sluice gate where a chain is attached to a rake to transport waste materials to the shelter that has been provided.*

c. *The trash rake has dimensions of length 1000 mm, width 500 mm, height 300 mm with a frame made of iron hollow while the trash rake is made from angle iron and pieces of ironstrip. The waste storage area is made of angle iron and the hole plate forms a square basket.*

d. *Automatic trash rake tool in rivers. The energy and power required to rotate the automatic trash rake tool is 216 watts ~ 0.216 Kw with a horse power of 0.3 HP; So an AC type motor with a power of 0.37 Kw was chosen; Power 0.5 HP.*

e. *The automatic waste rake tool in the river has worked effectively because it is capable of transporting waste reaching 1020 kg/hour or 0.28 kg/s so the tool's effectiveness value is 99%. This is because all types of rubbish floating on the surface of the water can be lifted by the rake.*

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