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THE ENCOURAGEMENT SYSTEM DESIGN UNMANNED AMPHIBIOUS VEHICLES

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ABSTRACT

Rupanpur is an Organic Unit of the Marine Corps Infantry Battalion which acts as the eyes and ears of the Battalion to provide intelligence data on the front situation of the battle to ensure the landing passage is safe from obstacles and enemies, so as to reduce the risk of casualties when Rupanpur is on duty, an Unmanned Amphibious Vehicle is needed. This tool is capable of operating both on land and at sea, and can be controlled remotely using a remote control. The Unmanned Amphibious Vehicle propulsion system consists of land and sea, for ground propulsion operations using a motor transmission system and sprockets, while for propulsion at sea using waterjet propulsion. From the calculation, the total resistance of the Unmanned Amphibious Vehicle is 16,628 N, so it requires a motor power of 33,25 watts or 0.04 HP with a speed of 2 m/second. As for the total resistance in water, the value is 5.52414 N, so it requires a Brushlees motor with a Shaft Horse Power (SHP) value of 24,2 watts. The results of the land and sea trials went well with a land speed of 2 m/second and a sea speed of 5 knots = 2,572 m/second.

Keywords: *Amphibious, Propulsion System, Waterjet*

1. INTRODUCTION

The Republic of Indonesia Marine Corps (Kormar RI) is a unit of the Indonesian National Armed Forces in its task of carrying out amphibious operations, coastal defense, securing the outer islands, fostering maritime potential, as well as fostering the strength and readiness of Marine units to operate. "The Combat Scout Squad (Rupanpur) is an organic unit of the Marine Infantry battalion that has the ability to move in front of the unit acting as the eyes and ears of the Battalion to provide intelligence and data on the front situation of the battle and guide the main troops in combat operations in order to support the main tasks of the Marine Infantry battalion. , which is under the direct command of each Pasmar 1, Pasmar 2 and Brigif 4 Marines. The Marine Field Investigation Team (Rulidiklap Marines) until now named Rupanpur is an Organic Unit of the Marine Corps Infantry Battalion. Rupanpur is one of the elite troops owned by the Marine Infantry Unit consisting of selected officers, non-commissioned officers and enlisted men. Therefore, every Rupanpur soldier is required to have good abilities and skills from individual and team abilities, Rupanpur acts as the eyes and ears of the Battalion to provide Intelligence data to the main unit, data on the front battle situation and guide the main unit in supporting the tasks of the Marine Infantry Battalion. . This battlefield (Rupanpur) is tasked with carrying out investigations and reconnaissance of the field and the enemy, the number of each team is twelve people equipped with light assault weapons. In carrying out its duties, Rupanpur is very risky for casualties, with Rupanpur it is hoped that each Marine Infantry Battalion will be able to destroy the enemy quickly and precisely, and be able to collect enemy and field data accurately. Therefore, there is a need for a breakthrough in a tool for the Rupanpur troops in carrying out the task of data collection and reconnaissance without being detected by the opponent. In this study the author will design an unmanned vehicle in the form of an amphibious armored vehicle with tire wheel drive, in this case the author attaches four wheels of solid tires to reduce the lifting force when watered, while for operation when under water use a single waterjet propulsion system. one brushed type DC motor with sprocket and chain transmission system so that it has effective and efficient cruising power to be controlled by Rupanpur with a range of approximately 1 Kilometer. This Unmanned Amphibious Vehicle is equipped with a camera to detect enemy forces to move both on land and in the water. It is hoped that the results of this study can simplify the task and reduce the risk of loss of personnel from Rupanpur.

2. MATERIALS AND METHODS

2.1 DC Motor

DC (Direct Current) motor is a type of electric motor that works using direct current, consisting of 2 main parts, namely the rotor and the stator. The rotation produced by this motor can rotate clockwise or counterclockwise. In this discussion, we will discuss the Brushed Motor and Brushless motor.

a. Brushed DC Motor

A brushed DC motor is an electric motor using a commutated mechanical system with a direct current (DC) source. A brushed DC motor has several main components to be able to convert electrical energy into mechanical energy, namely stator, rotor and mechanical commutation system. This type of motor generates a magnetic field in the rotor or "Armature", by passing an electric current through a carbon brush or charcoal brush. The stationary field is generated from the stator winding field or by permanent magnets. Stator magnets in brushed DC motors are mostly permanent magnets. But sometimes, there is also a coil in the form of an iron core. This type of motor rotor is usually a coil wound in an iron core. While this motor uses a mechanical commutated system in which a pair of brushed carbon is made in contact with the commutator. The function of the commutator is to connect power from a direct current source to the coil. The working principle of a brushed DC motor starts when a current passes through a circular conductor, causing a magnetic field to arise around the conductor. The emergence of this magnetic field triggers a push and a pull between the rotor and the stator so that a force arises. As a result of this force the emergence of torque makes the motor rotate.

b. BLDC motors

BLDC motors, also known as electronically commutated motors, are a type of synchronous motor that uses a direct current power source as the power source. The direct current used is generally sourced from alternating current which is then rectified. Because this motor does not use a brush, so to be able to determine the commutation timing requires 3 hall sensors. This hall sensor determines the rotor position, which will be reported to the controller for the entry of electric power to the motor. Basically, the working principle of a BLDC motor is quite simple, namely the magnet in the motor rotor will be attracted and pushed by the electromagnetic force which is regulated by the controller with the help of the driver on the BLDC motor. Furthermore, this electromagnetic force pushes the hollow cylinder so that torque arises to drive the motor with angular rotational speed. In operation, this BLDC motor cannot be directly Roll Chain And Sprocket Characteristics Roll Chain And Sprocket Characteristics connected to a DC current source. This motor requires a control system which will later regulate the commutation timing. As for the advantages and disadvantages of Brushlees Motors, the commutation system with this electronic method makes this type of motor have high efficiency, not too noisy because friction is minimized.

2.2 Transmission System

Transmission is a machine element that functions to transmit power. So far the transmission has undergone various developments, both in terms of design and the type of material used to transmit power from an engine. Transmission has many types of models and functions because it develops along with the increasing need for power suppliers. The following are the types of transmission:

a. Belt and pulley Belt is a power transfer device that is quite simple compared to chains and gears. The belt is attached to two pulleys (pules) or more, the first pulley is the drive while the second is the driven pulley.

b. The chain is a machine component that is strong and reliable in transmitting power through the pulling force of an engine. Chains are mainly used in power transmission and conveyor systems.Chains are most often used as a cost-effective component of power transmission engines for heavy loads and low speeds. Chains are better suited for non-stop applications with long operating life and power delivery with limited torque fluctuations. However, the chain can also be used in high-speed conditions.

c. Gears or often called gears are machine elements that can transmit greater power, higher rotation and accuracy when compared to belts or chains. In the manufacturing process, installation and maintenance require higher accuracy.

d. Chain and Sprocket is one element of the machine that serves to transmit power (Power Transmission.

Figure 1. Shaft

2.3 Roll Chain And Sprocket Characteristics

A roll chain is a chain which can be used directly and in an efficient manner to transmit power between parallel shafts. Roll chains are used when transmission (no slip) is required at speeds up to 600 m/min. Materials: pens, buses and rollers generally use carbon steel or chrome steel with surface hardening. While the sprocket material is usually used gray cast iron (FC25), carbon steel (SS41, S35C) and cast steel (SC46).

2.4 Bearing Planning

Bearings are machine elements that function to support the shaft, so that the rotation or movement of the shaft can take place properly and safely, as well as to minimize power losses due to friction. Bearings must be strong and sturdy to withstand the forces that occur on the shaft. If the bearing is not functioning properly, the work of the entire system will decrease or the machine cannot work properly. Bearings can be broadly grouped into two, namely:

a. Journal Bearing (Slide Bearing). In this bearing, sliding friction occurs between the shaft and the bearing because the surface of the rotating shaft is in direct contact with the stationary bearing. A layer of lubricating oil is needed to minimize the frictional force and temperature arising from the friction.

b. Rolling Bearings. In this bearing, rolling friction occurs between the rotating and stationary parts of the bearing; the rotating parts are ball, cylindrical and needle; between the shaft and the bearing, there is no friction.

2.5 Shaft Mechanism

The shaft is a rotating stationary part, usually round in cross-section, to which elements such as gears, pulleys, flywheels, cranks, sprockets and other shifting elements are attached. Shafts can receive bending loads, tensile loads, compressive loads or torsional loads acting alone or in combination with one another. The shaft in an engine functions to transmit power along with rotation. Each rotating machine element, such as rope discs, engine belt pulleys, cable discs, cable drums, road wheels and gears, is mounted on a rotating basis against a fixed support shaft or fixed on a rotating support shaft. For example, a rotating support shaft, namely the wheel axis of a cart, turns a faucet. Types of Shafts Based on the Loading:

a. Transmission Shafts

The transmission shaft is better known as the shaft. Subjected to repeated torsional loads, alternating flexural loads or both. Power can be transmitted on the shaft through gears, belt pulleys, chain sprockets, etc.

b. Axle

The axle is the axis installed between the freight train's wheels. The axle shaft does not receive torsional loads and only receives bending loads.

c. Spindle Shaft

For example, the spindle axis is a relatively short transmission shaft on a machine tool’s main shaft where the main load is a torsional load. In addition to torsional loads, the spindle axis also receives axial loads**.**

2.6 Waterjet Propulsion System

In general, the ship moves on the water medium at a certain speed, it will experience a resistance that is opposite to the direction of the ship's motion. The amount of drag that occurs can be overcome by the ship's own thrust (thrust) resulting from the work of the ship's propulsor. The power distributed (PD) to the ship's propulsion equipment is derived from the Shaft Power (PS), while the Shaft Power itself is sourced from the Brake Power (PB), which is the output power of the ship's propulsion motor. A ship is a water vehicle with an independent main propulsion system known as a propulsion system.

The waterjet propulsion system is a propulsion system that utilizes the thrust of water to move the ship at the desired operational speed. The thrust of the water on the waterjet propulsion system is generated by a pump driven by the ship's main motor, with seawater entering the suction part of the pump located at the bottom of the ship. Pressurized sea water will flow to the outside. At the end of the outer side used there is a nozzle as a tool to add pressure to the water that will come out. The water that comes out with high pressure creates a thrust of the ship opposite to the direction of the thrust from the pump. The use of this waterjet propulsion system is gaining popularity for ship applications that require high speed. There are four basic reasons waterjets are becoming widely used. The first thing is the simplicity of the system. The power generated immediately comes out without the need to go through the clutch and gear box. The second aspect is safety. There is no danger to swimmers under the stern of the boat. Then, you don't have to worry about the propeller going aground for shallow water. The last aspect is that it is easy to launch and move.

2.7 Waterjet Components

The waterjet system has the main components in determining its performance. These components include the engine propulsion and transmission system, pump, thrust nozzle equipped with a deflector, thrust vectoring and reversing mechanism, diffuser, ducting and inlet (intake). , this is due to an increase in the speed of the incoming flow through the channel and then causes a difference in momentum so that it can make the ship move forward according to the planned speed, with the actual thrust on the ship's waterjet system can move. The main concern of the waterjet system is the balance between the thrust required to propel. The ship's propeller is a ship's mechanical motion tool. The ship's propeller is a tool to generate thrust on a ship; the propeller is rotated with a shaft driven by the prime mover in the engine room. The types of propellers are as follows:

a. Propeller with fixed pitch propeller. This type of propeller is commonly used for large ships with relatively low rpm and high torque, more economical fuel consumption, minimal noise or vibration, and minimal cavitation. high fuel consumption is more economical, noise or vibration is minimal, and cavitation is minimal.

b. Contra-rotating propellers, This type of propeller has two-coaxial propellers mounted on one axis of the shaft, arranged one in front of the other and rotating in opposite directions.

c. Propeller with controllable pitch propeller. This type of propeller can be changed according to needs; for example, for low rpm, a large pitch is used, and for high rpm, a low pitch is used.

d. Overlapping Propellers The concept of this propeller is that the two propellers are not attached/tied coaxially, but each propeller has a shaft axis on a separate shaft system. In practice, this system is very rarely applied.

e. Waterjets Propulsion ships use a pump that sucks water at the front and pushes it backwards so that the ship can move forward with the principle of momentum. This drive is more efficient and safety

2.8 Waterjet Characteristics

The thrust generated by the propulsor in the presence of the flow of water momentum from the nozzle. This force is used in waterjet propulsion systems to propel fast boats. In the waterjet system, which gets bursts from the nozzle and produces a thrust for the ship so that the ship can move at a certain speed. The reaction between the fluid and the hull that will produce resistance. Fluid flow is the result of pump work that provides energy to the driving motor / engine to the working fluid.

a. Thrust

The ship's thrust is a very important component, which is used to overcome the ship's resistance or drag. In very ideal conditions, the magnitude of the required thrust may be as large as the drag on the ship. However, this condition is very unrealistic, because in fact in the hull of the ship there is a hydrodynamic phenomenon that causes degradation of the value of the thrust of the ship.

b. Effective Horse Power (EHP)

Effective thrust (EHP) is the amount of power required to move the ship at a certain speed. To find the EHP with the following equation:

$$EHP = RT \text{ x } VS$$

Where :

RT = Total resistance

VS = Service speed

3. RESULTS AND DISCUSSION

3.1 Research Design

Where in this research is carried out by carrying out designs that aim to create new innovations. However, in this final project, it also includes engineering research that applies science into a design which will later get performance in accordance with the requirements that have been set.

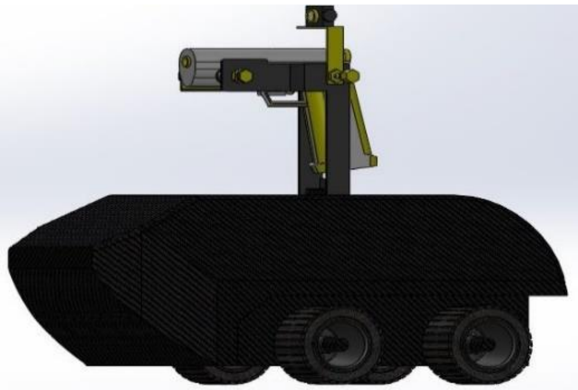

Figure 2. Vehicle design
Source: (Processed author's data)

The design synthesises design elements combined with the scientific method into a system that meets certain specifications. In this study, the design of the water jet selection and combination with the Unmanead Amphibious Vehicle tire system will be carried out. The waterjet propulsion system will use a 1 Dc Brushless motor. For the mechanism on the Tire Wheel, it uses 1 Brushed motor which is transmitted to the chain and sprocket, for its operation it is configured with a waterjet system. And for the movement Unmanead Amphibious Vehicle This is controlled using a remote controller.

3.2 Research Design

This process is carried out in stages, namely research design and planning, determining research focus, research time, data collection, analysis and presenting research results. Regarding the writing of the results of this research is done descriptively or through a description that describes and explains how the system works.

a. Design

System design is to make a system design or create a design that can be well integrated. The system's design is a combination of several procedure steps in processing data . It is hoped that the resulting procedure will support the operation of a running system.

b. System General Design

The system's design will be carried out after an analysis of the system, where in the design of this system can provide an overview of the system that will be made. In making this system, the researcher made a system design using the Flowchart system. This system describes the outline of all application systems that will be made, including from planning to completion.

3.3 Data collection

Data collection methods are needed in order to get the correct information so that the research can run according to plan. The stages of data collection include:

a. Collection of reference data, supporting theory, and data for each module and component through books, the internet and literature.

b. Collecting previous research data that can support writing.

c. Collection of reference data on Waterjet and Tire Wheel Drive Mechanisms in Unmanned Amphibious Vehicles.

3.4 Data processing

Data processing is the processing stage of the data that has been collected and then processed to be presented and applied in the system being studied by the author. The data processing technique that will be carried out in this final project research is to collect data from journals that can support the final project report and then calculate the resistance and efficiency of the propulsion system and drive mechanism on the tire wheel of the tool along with the operation of the tool on land and in the water. The real dimensions of the required waterjet can also be calculated by obtaining the total resistance.

With the waterjet data that has been obtained, we can choose a waterjet that is suitable for this tool with the Unmanned Amphibious Vehicle driving system on the market. Then draw the mechanism with the dimensions obtained from the existing calculations. The test is carried out by evaluating and testing the functions contained in the system. When an error is found in the system, it will be repaired and evaluated or tested until it runs optimally according to needs.

4. ANALYSIS AND DISCUSSION

4.1 System planning

In general, the system is a unit of a series of tools, both real or abstract objects consisting of various components or elements that are interrelated, interdependent, mutually supportive, and as a whole unite in one unit to achieve certain goals effectively and efficiently. The purpose of implementing the tool system is to explain the planning and design of a distribution system that works on a research tool. So that testing the system will get the response as required by the input and output power in this study for the better.

4.2 Tool Deployment Plan

To discuss the placement of tools is the most important part in the manufacture of the main body designed in this final project. the concept of tool placement is based on theory and related references to the tool that will be designed to make it easier to work on and analyze the tool. Then for the scheme made with the intention of facilitating the design of the components and supporting tools so that they can move the unmanned amphibious vehicle on land and at sea, the positioning of the DC motor as well as the axles and servo motors.

4.3. Drive Motor Selection

The motor is the main component that functions to drive the sprocket and chain transmission system in the movement of unmanned amphibious vehicles on land. Calculations are carried out to get the desired motor according to the existing load. In the calculation of the load has a mass (m) of 24,184 kg, so the speed on the ground for the function of the vehicle as a troop guide is planned to have a speed of (v) 2 m/second. Power requirement is the amount of power needed to move the tool. The weight of the tool influences the amount of power required, the coefficient of friction between the tires and the ground, the rolling resistance of the wheels/tyres.

4.4 Total load/Total resistance (FT)

The total load is the sum of the frictional force (Fs), rolling resistance (Fr), acceleration force ($F.aks$), incline force ($F.hill$). The total resistance load (FT) can be calculated by the following formula:

$$F_T = F_s + F_r + F.aks + F.hill$$
$$= 2{,}844\,N + 2{,}135\,N + 12\ N + 40{,}29\,N$$
$$= 16{,}628\,N.$$

So the total resistance (FT) obtained is $16{,}628\,N$.

The desired vehicle power is obtained by multiplying the total resistance load (FT) by the speed (v). Speed is obtained from the desired assumptions. For unmanned amphibious vehicles the desired speed is 2 m/s.

The desired motor power can be calculated by the formula:

$$P = F_T \text{ x } v$$
$$= 16{,}628\,N \text{ x } 2\,m/s$$
$$= 33{,}25\,watt$$
$$= 0{,}04\,HP$$

Meanwhile, to find the required torque:

$$T = 9{,}55\ \frac{P}{rpm}$$
$$= 9{,}55\ \frac{33{,}25\,watt}{2720}$$
$$= 0{,}22 \text{ Nm}$$

The result of calculating the DC motor power and the torque needed to drive an unmanned amphibious vehicle is a DC motor with a power of 0.04 HP and a torque of 0.22 Nm.

4.5 Counting the number and length of chains

The calculatedd number and length of chains are:

a. Calculation of the number of chains

The following formula can calculate the number of chains:

$$K = \frac{T_{B+}T_K}{2} + \frac{2\ X}{P} + \left(\frac{T_{B+}T_K}{2\,\pi}\right)^2 + \frac{P}{X}$$
$$= \frac{20+12}{2} + \frac{300}{8} + \left(\frac{20+12}{6.28}\right)^2 + \frac{8}{150}$$
$$= 16 + 37.5 + 25.90 + 0.05$$
$$= 53.5 + 25.95$$
$$= 79.45$$
$$= 80\ mm$$

b. The formula can calculate the chain length usedChain Length

The chain length used can be calculated by the formula:

$L \quad = K \times p$

$= 80\ mm \times 8\ mm$

$= 640\ mm$

4.6 Calculation of Shaft Diameter

In the calculation of the shaft the author must know the maximum allowable stress that applies to the nickel chrome steel shaft (JIS G 4102). To calculate the diameter of the appropriate shaft design the author uses the MSST theory of failure analysis as follows:

$$\frac{sy}{Sf} \leq \sqrt{\left(kf \cdot \frac{SY}{Se} \cdot \frac{32\ .M}{\pi\ d^3}\right)^2 + 4\frac{16\ T^2}{\pi\ d^3}}$$

$$= \sqrt{\left(2 \cdot \frac{462}{40.524,6} \cdot \frac{32 \text{ x } 38,54}{3.14\ d^3}\right)^2 + 4(\frac{16 \text{ x } 633.6}{3.14\ d^3})^2} \leq \frac{462}{2}$$

$$= \frac{\sqrt{\left(2 \text{ x } 0,011. \frac{392,56}{d^3}\right)^2 + (\frac{12.914}{d^3})^2}}{\frac{462}{2}}$$

$$= \frac{\sqrt{\frac{8,63^2+12,914^2}{d^6}}}{231^2}$$

$$d \geq \sqrt[6]{\frac{8,63^2+12.914^2}{231^2}}$$

$$d \geq \sqrt[6]{\frac{74,47 + 166.771}{53.361}}$$

$$d \geq \sqrt[6]{31,2} \qquad d \geq 17\ mm$$

So for the axles on the wheels at least have a diameter of 17 mm, with the results of these calculations, the researchers used the axles on the wheels of the Unmanned Amphibious Vehicle.

4.7 Waterjet Propulsion System

4.7.1 Date Size And Determine Resistance

The data and measurements in the design that are important in determining the calculation of this writing are as follows:

LOA : $0,705\ m$
LWL : $0,65\ m$
LPP : $0,60\ m$
B : $0,325\ m$
H : $0,29\ m$
T : $0,20\ m$
R_T : $4,8036\ N$
ρ : $1,025\ \frac{Kg}{m^3}$
Vs : $5\ knot\ (2,572\ \frac{m}{s})$

The data above will be used in calculating the motor power and will then be used as part of the parameters and testing to get the motor power of the unmanned amphibious vehicle, the following variables are calculated.

4.7.2 Efektived Horse Power (EHP)

In this study, the unmanned amphibious vehicle was designed to achieve the desired operating speed. The main motor and propulsion system are designed in such a way that the expected speed can be met. Effective Horse Power (EHP) is the power required to move the ship in the water or to pull the ship at trial speed (Vs) and against the total resistance of the ship (RT). Effective power (PE) or Effective Horse Power (EHP) is obtained by using the following equation:

$EHP \ = \ Rt\ x\ Vs$
= 4,8036 N x 2,572 m/s
= 12,35 watt
= 0,016 HP

4.7.3 Push Force Required

In this study, the authors plan to use one main motor. The following is for the calculation of thrust:

$$T \quad = \frac{R_T}{(1-t)}$$

Where:

The value of the thrust deduction factor (t) for high-speed ships with a waterjet propulsion system, t = 0 (assumed for the initial calculation stage), so that the required thrust force is equal to the total resistance that occurs.

$T \quad = \ Rt$
$= \ 4,8036\ N$

So that the initial estimate in the design of this water jet propulsion system is the Overall Propulsive Efficiency (OPC) price of 0.50 so that the amount of BHP is obtained as follows:

$BHP \quad = \ T\ x\ \frac{V_S}{OPC}$

$= 4,8036\ \ N\ \ x\ \ \frac{2,572}{0,50}$

$= \ 24,7\ Watt$

$= \ 0,033\ HP$

In this waterjets pump system, it is planned that the pump impeller is driven by a motor with a direct coupling, with a transmission efficiency (ηT) between 0.96 – 0.99. In this planning the price of 0.98 is taken so that the SHP can be calculated as follows:

$SHP \quad = \ BHP \text{ x } \eta_T$
$= \ 24,7\ watt \text{ x } 0,98$

$= \ 24,2\ watt$

$= \ 0,032\ HP$

4.7.4 Efficiency Calculation

The ratio between the speed of the ship and the flow velocity (μ) passing through the jet can be expressed by the following formula:

$$\mu = \frac{V_s}{V_j}$$

$$= \frac{2{,}573}{3{,}72}$$

$$= 0{,}96$$

In calculating the Waterjets Efficiency, the author in this case is looking for the ideal jet efficiency ($\eta j\ ideal$) can be expressed by the following formula:

$$\eta_j\ ideal = \frac{2\ .\ \mu}{1 +\ \mu}$$

$$= \frac{2 \text{ x } 0{,}96}{1 + 0{,}96}$$

$$= 0{,}97$$

For the design of the water jet propulsion system, it is suggested that the inlet loss coefficient (ψ) is between 16% - 20%. In this calculation, the estimated price of the inlet loss is 20%. While the price of the loss coefficient on the nozzle (ζ) is suggested between 1% - 4%. In the calculation of the efficiency of the jet, the estimated loss on the nozzle is 4%. Because the losses at the nozzle are smaller when compared to the losses at the inlet line. So with the following equation, the actual jet efficiency price (actual ηj) for the water jet system can be calculated as follows:

$$\eta j\ aktual = \frac{1}{1 \text{ x } w} \text{ x } \frac{2\ .\ \mu .(1-\mu)}{(1+\psi) - (1-\zeta)\ .\mu^2 + \frac{2\ .\ g\ .h_j}{V_j}}$$

$$= \frac{1}{1 \text{ x } 0{,}05} \quad \frac{2 \text{ x } 0{,}96\ (1- 0{,}96\ )}{(1+ 0{,}20\ ) - (1- 0{,}04\ )\ (0{,}96)^2 + \frac{2 \text{ x} 9{,}8 \text{ x} 1}{3{,}72}}$$

$$= \frac{1}{0{,}05} \text{ x } \frac{0{,}768}{1{,}20 - 0{,}96 \text{ x } 0{,}9216 + 7{,}935}$$

$= 0{,}56$

5. CONCLUSION

5.1 Conclusions

Based on the results of planning, design, data collection, manufacture, testing and measurement of tools and during the preparation of this Final Project, the following conclusions are obtained:

a. From the results of the calculation of the power or power needed to drive an Unmanned Amphibious Vehicle which has a total weight of 24,184 Kg on land, at least using a 12V Brusheed DC motor which has a power specification of 33,25 watts or 0.04 HP, and has a minimum torque of 0.27 Nm

b. For power at sea, the required value for (BHP) is 24.7 watts in the selection of waterjets that need to be known is the power value on the shaft horse power (SHP), and the SHP value for 1 waterjet is 24.2 watts. So using a Brushlees F54 3650 motor.

5.2 Recomendations

Recomendations from the author for this research are:

a. Based on this research on Unmanned Amphibious Vehicles, the author hopes that in the future STTAL can continue and develop this research, development which is not limited to the propulsion system but more to all systems from the tailgate design and control system.

b. In the use of tools with better wear time, it is recommended to use a DC Brushed motor specification and a higher Brushlees Waterjet motor so that it can provide maximum performance, with a more perfect waterjet, the tool will be more effective and efficient in providing thrust to the user so that it can used by TNI-AL soldiers in general and Rupanpur Soldiers in particular, both for training and operational tasks

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