

20-2019

by Adam Malik

Submission date: 07-Apr-2023 09:33PM (UTC+0700)

Submission ID: 2058395979

File name: rosiding_Internasional_Terindeks_Scopus_Dr._Adam_Malik,_M.Pd.pdf (861.86K)

Word count: 3113

Character count: 14599

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To cite this article: A Malik *et al* 2019 *J. Phys.: Conf. Ser.* **1402** 044086

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4 [RAV] current meter: Manufacture a measuring instrument of water current using a spring balance

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Abstract. This research aims to build physics tools of measurement of river flow is current. The tool was developed with the balance spring as a means of collecting the data. data measurement results then analysed mathematically. It is designed using chloride polyvinyl (PVC) which is waterproof. The result of the test tool shows the average error value of 0.3342% and the value of the standard deviation of 0.1893. So, it can be stated that RAV current meter has a level of accuracy and the level of accuracy that is high enough. This equipment still needs to be optimized by performing test audiences to see the ease of the user. In addition. the size of the adjustment to the attention of the research further.

1. Introduction

The movement of the water flow's speed is called with the current flow of the river or stream. The stream much utilized in human life such as a means of water transportation, the system as a means of irrigation, fish farming, and as a power plant by utilizing currents of water to turn the turbines at the power plant water power [1-4]. Optimum utilization of water currents when the water flows at a certain quantity and current flow of water would be disastrous and source of danger when it is at such a high-intensity flash flood, flood, landslide, and erosion. The disaster caused by the flow of water has a lot of casualties and destroying a wide range of infrastructure. Some cases of damage produced by the water including 1) irrigation, crop irrigation conditions exceed the required quality will damage crops. 2) sports, if the conditions of the current of the river are very large then it can endanger the connoisseur rafting and 3) infrastructure, if the amount of discharge flow of the River does not meet the requirements turbine, then the electricity generated by hydropower shall be reduced [5-6].

That explanation to be one of the things that became the background assumption of research topics in the form of the development of the measuring instrument was able to measure the flow of the river. Researchers and technicians have previously made a piece of equipment that is able to measure the speed of river flow, the equipment is called a water current meter. Water current meter is a tool to measure the flow velocity or flow of a river. This tool is generally used in countries that make use of the river as a means of transport and also to find out the potential of the electricity to be generated by a hydroelectric power plant (water power). The working system of this tool is to measure the current flow of the river is then displayed in the form of numbers with units of velocity (m/s). Water current meters have a lot of experience of development in the industrialized world.

The development of this measuring instrument has been widely performed with different designs and various tools. The base material used also varied ranging from simple by using the tools in the form of substances and buoy up to colour that uses a radioactive substance (isotope). Water current meters that are circulating in the community as a tool to measure the speed of the flow of the river using the principle of rotation of the rotor which is then recorded, analysed and translated into a linear speed of river flow quantities. The making of water current meters have been widely developed by applying various related physics concepts and technological applications including using pitot tubes [7], G1/2 hall effect water flow sensor [8], buoy [9], sinusoidal wave [10], and the principle of flow velocity [11]. The type of water current that is currently being produced by the factory is water current which uses a sensor in the form of a rotor/propeller. Novelties from this research developed a water current meter using a tool in the form of a spring balance.

2. Method

The research method uses research and development which consists of three stages, namely preparation, design, testing and evaluation. The preparation phase is carried out by conducting a literature review related to the making and working principles of the RAV and also the design of the RAV form/design. The study of the basic ingredients of making RAV also exercised taking into account the availability of materials and the state of materials on the environment. Next stages phases of implementation. Stage of implementation of this research was conducted with the making of the RAV and fix any flaws of the design that has been created. The last phase of this research is a performance testing tool. The test is done by measuring the speed of the flow of the River in the area Cibiru. The performance results of the tool have been then analyzed and evaluated. An evaluation performed covering about ease of use tools and measurement results. Both indicators are used for reference in making improvements that aim to optimize the function of the tool.

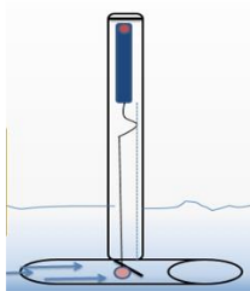


Figure 1. Experiment tool.



Figure 2. Data withdrawal.

The experiment results of tool then compared with the results of the measurements manually by using the buoy floated on the surface of the river. Distance buoy then measured and divided by the value of travel time resulting from the flow of the river water. This is in accordance with the initial equation of speed:

$$\Delta V = Av\Delta t \quad (1)$$

Water is a substance that is a liquid that cannot be compressed (does not change volume when given pressure). This property allows the volume of fluid passing through a cross section to be the same as the other cross section. This provides an explanation that if water passing through a different cross-section of size is required in a larger flow rate to compensate for changes in volume [12]. The process of colliding the flow of water with objects around it causes changes in the flow so that in some cases the flow is formed in a circular motion [13]. In addition, there is a relationship between water depth measurements with water volume, water level, and water flow velocity indicating a linear relationship. The maximum value of water flow occurs when the water depth value is close to zero or the minimum value flow occurs when the depth reaches the maximum [14-15].

The use of the balance of spring as the basis of the concept of force associated with RAV and pressure. Force and pressure are a physic quantity that is associated with the given external behaviour. His own force was defined as a push or pull that work on an object. While the pressure was defined as the magnitude of the forces acting on an object mathematically cross section in the form of the following equation:

$$P = \frac{F}{A} \quad (2)$$

As we know that force is a vector quantity which in addition has a value also have directions. The direction of the style can be seen from the direction of the movement or direction of a given pressure. The forces acting on an object can be measured magnitude using the tools in the form of the balance spring.

In general, the balance springs serve to weigh heavily (force gravitation which works on an object) of an object. Working principles of the balance spring are to use the concepts and equations of the law Hook. Hook's law states that the increase in the length of a spring on a par with the forces acting on the spring and inversely proportional to the value of the spring constant. Mathematically this statement was written with the equation

$$F = -k \Delta x \quad (3)$$

where x is the elastic deformation and k (constant) indicating the difficulty level to change the state of the system.

The relationship of the force measured on the balance of spring with the current measurement using the RAV water current meter is done by making use of the momentum generated by the collisions of the particles of the water with a cross section that serves as a censorship tool. Overall, the basic principle of the creation of this tool is the momentum, force, pressure and law Hook. The relationships between the concepts of physics in the making of these tools can be seen in the following equation:

$$v_t = v_0 + at \quad (4)$$

$$v_t^2 = v_0^2 + 2a\Delta l \quad (5)$$

$$a = \frac{(v_t^2 - v_0^2)}{2\Delta l} \quad (6)$$

$$F = m a \quad (7)$$

$$F = m \cdot \frac{(v_t^2 - v_0^2)}{2\Delta l} \quad (8)$$

$$F = -k \Delta x \quad (9)$$

$$m \frac{(v_t^2 - v_0^2)}{2\Delta l} = -k\Delta x \quad (10)$$

Since $v_t = 0$ then the above equation can be transformed into:

$$-m \cdot \frac{(v_0^2)}{2\Delta l} = -k\Delta x \quad (11)$$

$$2k\Delta x^2 = m v_t^2 \quad (12)$$

$$v_t = \sqrt{\frac{2k}{m}} \Delta x \quad (13)$$

Until the end of the equation, we see the relationship of the speed at which the measured value will be the same length spring and the spring length value is directly proportional to the cross-sectional area [16].

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3. Result and discussion

The test results showed that the gauge tool flow of the river RAV work according to the draft and show accurate results.

Table 1. Result of measurements of river flow with RAV.

No	Cross-section			
	A v (m/s)	B v (m/s)	C v (m/s)	D v (m/s)
1	3.33	2.15	1.41	0.63
2	3.12	2.84	1.98	0.75
3	3.12	2.84	1.98	0.75
4	3.33	2.32	1.7	0.38
5	2.91	2.58	1.98	0.75
6	3.12	2.58	1.98	0.38
7	3.12	2.58	1.41	0.38
8	3.12	2.58	1.7	0.75
9	3.33	2.32	1.7	0.75
10	3.12	2.32	1.7	0.75
11	3.12	2.58	1.7	0.75
12	3.12	2.32	1.7	0.75
13	3.33	2.32	1.98	0.75
14	3.33	2.32	1.7	0.38
15	3.12	2.58	1.98	1.13
16	3.12	2.32	1.98	0.75
17	3.12	2.32	1.7	0.75
18	2.91	2.58	1.7	0.75
19	2.91	2.32	1.7	0.75
20	3.12	2.32	1.7	0.75

Table 2. Test results for accuracy of RAV data.

No	Velocity of experiment (m/s)	Velocity of reference (m/s)
1	0.63	0.63
2	0.75	0.64
3	0.75	0.66
4	0.38	0.65
5	0.75	0.64
6	0.38	0.64
7	0.38	0.65
8	0.75	0.63
9	0.75	0.63
10	0.75	0.62
11	0.75	0.64
12	0.75	0.67
13	0.75	0.67
14	0.38	0.67
15	1.13	0.66
16	0.75	0.67
17	0.75	0.63
18	0.75	0.66
19	0.75	0.66
20	0.75	0.65

Based on the data Table 1, the cross-sectional area of $1 > 2 < 3 > 4$ so that it can be concluded that the relationship between the cross-sectional area at the speed which is measured is inversely proportional. This is caused because the formula approach used. The equation derived is the analysis of the automatic object. Such circumstances are met when the cross-section is used as a broad dimension is small. So, the measurement results and references have a smaller error. The data in Table 1 can be shown in the graph in Figure 3 as the average relationship between the cross-sectional area with speed scalable streams [17,18].

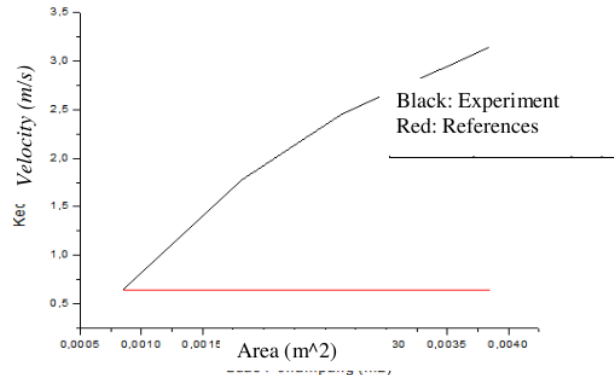


Figure 3. The graph of the relationship of speed with a broad cross-section.

Based Table 2, data accuracy level when a cross-section of 1 is used. Based on the data retrieved the value of the error between the measurement results with the reference reaches 0.3342% with a standard deviation of measurement results 0.1893. This indicates that the data obtained using RAV has high accuracy and good reliability [19-20]. The limitation of this study is that the experimental data has not been calibrated with standard instruments, only compared to existing references. therefore, further research is needed to obtain accurate data. Calibration results from RAV current meter measurements can be done using traditional methods or with technology [21-23].

1 4. Conclusion

We have succeeded in conducting research on the analysis of viscosity coefficient characteristics using viscometer stromer. The viscometer stromer made in this study comes from simple materials and equipment found in many daily lives. Based on the results of research, the relationship between the viscosity coefficient is inversely proportional to time. If the value of the type of substance viscosity coefficient is greater, the time needed will be less, and vice versa. The viscosity coefficient of water and dish soap decreases when the mass is given bigger. Only the value of the oil viscosity coefficient is greater if the mass given is getting bigger. Thus, the viscometer stromer made can prove the difference in the viscosity coefficient of some liquid.

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