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Increasing Skills for Processing Rainwater into Clean Water using the Electrolysis Method

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Abstract

The purpose of community service activities from the Collaborative Team of Civil Engineering and Chemical Engineering, UNNES at Patemon is to improve community skills in treating rainwater so that it is suitable for consumption using the electrolysis method which has been tested for its effectiveness and quality in the laboratory first. The Patemon area is an area whose water source is from wells, has a slope of 10-45% so that during the dry season it experiences a shortage of water discharge. The very high rainfall in Patemon is an average of 1853 mm/month, which has the potential to be processed into clean water as a solution for availability in the dry season. The methods used for this community service activity include field observation and coordination, training to improve skills in improving rainwater treatment using electrolysis, monitoring and evaluating the results of community service. The results obtained from this activity are that electrolysis of rainwater is an appropriate alternative for the availability of clean water in the Patemon area. The education provided by the UNNES service team has increased the community's knowledge and skills in rainwater treatment from 8% to 35%. Increased knowledge regarding rainwater harvesting from rainwater electrolysis systems and working principles from 0% to 85%. Enthusiasm and interest in the implementation of activities reached 98%

Keyword: clean water, rainwater, electrolysis, patemon

INTRODUCTION

Artetic wells have become an alternative source of drinking water so that almost every resident's house has a well. Some people in the Patemon area have wells which are used to meet their daily needs for drinking water [1]. However, because the geographical structure of the land in the Patemon sub-district area has a fairly high slope, this means that during the dry season, the well water cannot flow back. Patemon Village is located at 7°2'8.11" South Latitude - 7°3'37.87" South Latitude and 110°22'40.20" East Longitude - 110°24'24.91" East Longitude. Patemon Village has three categories of slope classes, namely class II in the gentle category for slopes of 10-15%, class III in the slightly steep category for slopes of 15-25%, and class IV in the steep category for slopes of 25-45%.

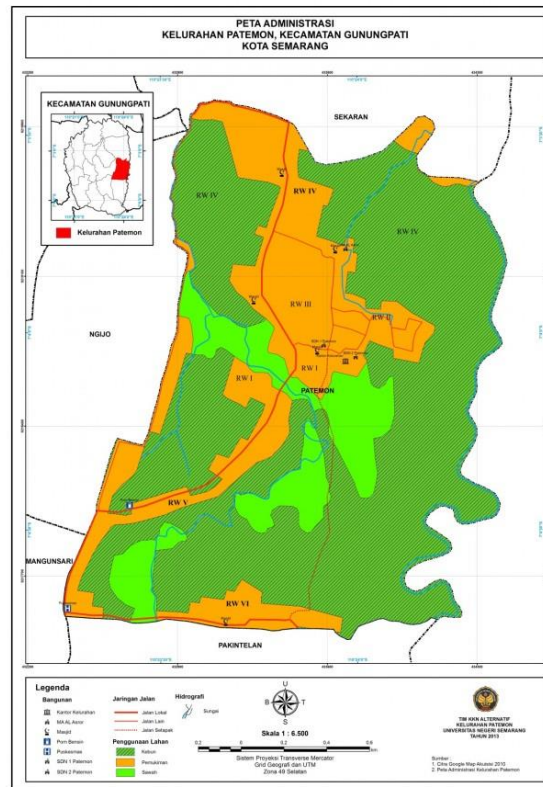


Figure 1. Map of the Patemon Village Area (<https://patemon.semarangkota.go.id/profilkelurahan>)

The Patemon area is located at an altitude of 259 m above sea level, the topography is included in the hilly category so the depth of artetic wells reaches 66 m [2,3]. The steeper the slope, the greater the rate and amount of surface flow and the greater the erosion that occurs. Apart from that, more soil particles are splashed due to the impact of raindrops. This is due to the greater gravity force in line with the increasingly slanted surface of the land from the horizontal plane so that the top layer of soil more and more will be eroded [4]. This can affect water quality because the steeper an area the water will flow smoothly from higher areas to lower areas through gaps according to the topography of the area it passes through and erosion or erosion will easily occur, the erosion process transports dissolved materials. , chemical elements as well as small organisms and the top layer of soil are transported so that they can affect the quality of water towards the slope below, namely in lower areas, areas that are more sloping the water quality is better but in flat areas the quality is worse because the area Flat is a place for sedimentation from erosion [5].

The situation analysis above can be understood as an effort to overcome problems with water conservation by processing rainwater using electrolysis technology to become clean water. Clean water or drinking water is a basic need that is very important for human health and survival. [6] Water in the human body has a composition in several parts such as the brain which consists of 74% water, muscles about 75.6%, blood contains 83%, and kidneys 82.7%, even bones contain 22% water. The need for drinking water per person per day is 10 liters according to the minimum standard pyramid of water requirements [7]. With the rapid population growth in the Patemon Village area, the use of clean water will increase. Apart from clean water obtained from groundwater [8]. The supply of clean water from groundwater is very limited and does not meet drinking water requirements. This condition makes water sources such as the use and processing of rainwater an alternative that needs to be considered, so that it can reduce groundwater extraction and reduce transaction costs for buying and selling drinking water [9]. Excessive use of groundwater results in a decrease in groundwater levels and results in seawater intrusion, humans tend to depend on polluted water sources as a source of raw water, water problems have become a national and international issue in many countries in the world [10]. Several of these problems encourage the use of appropriate technology in rainwater harvesting processing to

provide clean water sources. Considering the importance of the benefits and impacts of access to clean water, clean water is one of the targets of the *Sustainable Developmental Goals* (SDG's) [11].

Efforts have been made to overcome partner problems, so an alternative solution is recommended in the form of electrolysis technology to process rainwater into clean water. The electrolysis technology used uses an electrode in the form of a titanium mesh cathode [12]. The use of this cathode results in an increase in the alkalinity level and there are no impurities contained in it. Processing rainwater into clean water, first it is necessary to know the conditions at the rainwater harvesting location and the characteristics of the rainwater to be processed, and the test results in the UNNES Chemical Engineering Operations laboratory, the pH of rainwater in the Patemon area is 5-6 with an average rainfall 1853 mm/month[13]. The characteristics of rainwater can be determined by carrying out a laboratory testing process on several parameters required to meet drinking water quality standards [14]. The quality of rainwater is good, almost does not contain contaminants, but in the case of rainwater harvesting, of course the rainwater that falls and will be harvested comes into contact with several materials in the surroundings, either through the air, the rain catchment area (house roof), distribution pipes. rainwater and storage[15-16]. In processing rainwater as clean water, it is hoped that several things will be taken into account that will not harm the user, where the considerations taken are the amount of costs required for processing, ease of operation, ease of installation maintenance, and processing efficiency to obtain standards [17]. .

METHOD

Time and Location of Activities

The time for implementing community service activities is from April to July 2023. The location of the activities is in Patemon Village, Gunungpati, Semarang, located at Jl. Mr Koesbiyono Gg. Semboja No. 12 RT. 02 RW. 01. Gunungpati District, Semarang City 50228, Tel. (024) 764 204 85.

Activity Stages

This community service activity is carried out in three stages, the first is observation and coordination, the second is the implementation of training to improve skills in processing rainwater into clean water using the electrolysis method and the third is monitoring and evaluating the results of service activities. The observation stage was carried out by reviewing the location for rain harvesting, the availability of tools and materials in the community that could be used, coordinating with the Head of Patemon Subdistrict (Mr. Mohamad Khosim). The activity stage consists of socialization activities and activities for making household-scale rainwater electrolysis equipment which will be carried out on July 14 2023 at the Patemon Village Hall. This implementation activity was attended by 40 participants and local leaders (Village Secretary Mrs. Nitta Tsuroyo, S.Pd., SE, M.Pd). The socialization material was delivered by Prof. Dr. Nur Qudus, MT, IPM about rainwater, harvesting and its use, and this is in accordance with his expertise in hydrology. The next stage was training in making rainwater electrolysis equipment which was carried out by the service team from Chemical Engineering involving the participants present. This skills training stage explains the working principle of a rainwater electrolysis device using materials that are easy to obtain and at affordable prices and low electricity costs. The monitoring and evaluation stage of service activities is carried out by collecting questionnaire data for participants regarding increasing knowledge, enthusiasm and interest as well as the benefits of service activities.

RESULTS AND DISCUSSION

Socialization and skills training activities aim to provide education regarding rainwater harvesting, the benefits and solutions to the lack of water availability using the electrolysis method.



Figure 2. Socialization by Prof. Dr. Nur Qudus, MT, IPM about rainwater, harvesting and its use

During the socialization, education was provided in the form of an understanding of the need for water for humans to drink so that the body gets fluids to maintain metabolism. Drinking water can be obtained through rainwater processing, because it has advantages, including: rainwater is a free object, it does not require costs to obtain it, the costs are only in the process of collection and use; Rainwater can be an alternative source when groundwater cannot be used, rainwater reduces water demand at dry peaks, harvesting and processing rainwater reduces the costs of using gas, electricity and PAM. There is also an explanation of the hydrological cycle, which is a natural process that is important for human life. This cycle is the process of moving water until it becomes water vapor. The benefits of rainwater have also been written in the Qur'an QS An-Nahl : 10 which means "He is the one who has sent down rainwater from the sky for you, some of it as a drink and some of it (fertilizes) the plants, which are in (the place growth) you graze your livestock." So there is no doubt that rainwater, if processed effectively, will become a source of drinking water that is suitable for consumption by the body.



Figure 3. The Service Team explains how to make it and the working principle rainwater electrolysis device

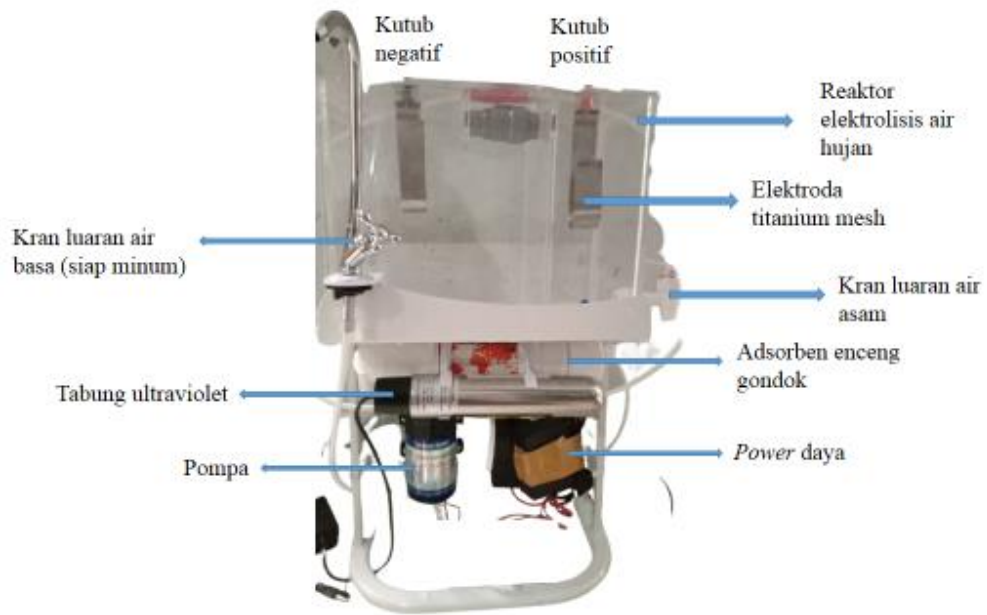


Figure 4. Household scale rainwater electrolysis device

The rainwater electrolysis device implemented in Patemon uses titanium mesh electrodes which have an impact on electron transfer resulting in an increase in pH, a reactor/container for a volume of 25 liters of water, a current adapter of 0.5 ampere and a voltage of 220 volts, the electrolysis process time is 15 minutes. So the need for electricity used during the electrolysis process is around Rp. 600.00 to Rp. 1,000.00. The adsorbent used comes from water hyacinth and an ultraviolet tube is added to eliminate pathogenic microbes and improve water quality. The working principle of rainwater electrolysis is the movement of positive ions to negative ions to produce alkaline water (drinking water), and the movement of negative ions to positive ions to produce acidic water (which can be used as plant fertilizer). Water molecules can be broken down into their original elements with the presence of an electric current. Rainwater in the Patemon area contains an initial pH of 5-6 and after electrolysis the pH becomes 9-10. The next stage of service activities is evaluation and monitoring by collecting questionnaire data from participants which is presented in table 1.

Table 1. Results of activity evaluation and monitoring questionnaires

Indicator	Before Community Service Activities		After Service Activities	
	Response	Percentage	Response	Percentage
Knowledge and understanding of rainwater, hydrological cycle, utilization	Do not know	70%	Do not know	0%
	Just knowing	25%	Just knowing	0%
	Know	5%	Know	85%
	Very knowledgeable	0%	Very knowledgeable	15%
Knowledge of how rainwater electrolysis systems work and systems	Do not know	100%	Do not know	0%
	Just knowing	0%	Just knowing	0%
	Know	0%	Know	90%
	Very knowledgeable	0%	Very knowledgeable	10%
Enthusiasm and interest in service activities	Not interested	0%		
	Quite interested	0%		
	Interested	25%		
	Very interested	75%		
Hope for the continuation of the service program from the UNNES Team			Not continue	0%
			I want continuity	10%
			I really want continuity	90%

The table shows that community service activities in collaboration with the Department of Civil Engineering and Chemical Engineering, Faculty of Engineering, Semarang State University increased the knowledge of the people of the Patemon area about processing rainwater to become clean water suitable for consumption through the application of electrolysis science and technology. On this occasion, the Patemon Village Secretary, Mrs. Nitta Tsuruyo, S.Pd., SE, M.Si. also said that the program implemented by the UNNES service team was very useful for educating and providing rainwater processing skills for the people of Patemon Village. It is the hope of the Patemon leadership that the knowledge that has been conveyed can be applied by the community so that it can be a solution to the problem of drinking water for the local community.

CONCLUSION

The use of the electrolysis method for processing rainwater is effectively used to produce clean water in the Patemon environment, Gunungpati Semarang. Tools and materials that are relatively easy to obtain and affordable costs are the reasons why this activity is popular and people are enthusiastic about participating in service activities. The results of clean water from the electrolysis process with a pH reaching 9-10 are also an advantage of using this method. Because clean water with a high pH can provide benefits for body health. The community hopes that there will be continuity of community service activities that can provide education regarding rainwater and its processing methods so that rainwater that is free and easy to obtain can be utilized.

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