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Research Paper

Determination of Filtration and Purification System for Flood Water Filter

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Abstract

Water is one of the basic needs which essential to life but cannot take it easy, it becomes more concern when a flood, there is plenty of dirty water than clean water, and the sources of the water are not approved to use. There are many kinds of waterborne pathogens which can donate diseases also death if not treating the water well before use. The treatment can be utilized based on the size of the microorganism. By identifying the size of the smallest bacteria will make easier to find the filtration based on the size of filter pores and other processes to ensure all the bacteria is removed and the water safe to use. Even there are many kinds of bacteria or microorganisms in the contaminated water, but the pathogens need to deal. The water will become clean and safe to use when the colour is clear and there is any pathogenic microorganism in there. This study is to ensure water is clean from pathogen after the flood water is filtered by know for sure the organism's size and to overcome the lack of clean water problem during the flood and others purpose.

Keywords: *Flood water filter; contaminated water; water treatment; waterborne Pathogenic; filter technology study.*

1. Introduction

Clean water is important for good health. Even in the house, the water from the tap needs to boil or filter before drink. That is to ensure the bacteria from the tap water are clear and safe to drink. There is no worry in the house because the tool for filtration and boiling is sufficient to generate drinking water. Every effort should be prepared to attain a drinking water quality as safe as possible [1-3]. It has become the problem to generate the clean water, especially for the drink in case of a flood. Also, the health risk becomes even more seriously if the polluted flooding water may enter the water supply system through leaking pipes [4-6].

Flood is the natural disaster which causes the most damage of human hardship and economic loss [7-13]. For example, Malaysia has been facing a severe flood disaster in 2014. Continued heavy rain causes water rise at a dangerous level and extends to other states which are Kelantan, Pahang, Terengganu and Perak. The disaster claimed 21 lives and there were 85,000 families displaced even after two months of disaster because of lack clean drinking water and electricity [14]. As well as Japan this faced with Tsunami on March 2012 after a year of earthquake. The lack of liability of Japanese authorities which only concern towards economic more than safety has contributed to 15854 dead, 3167 missing and 26992 injured across twenty prefectures, reported by Japanese National police Agency. The Ministry of Health was in charge of preparing suitable vehicles for supplying water from other country and assigning hospitals for remedy of casualties and people who have been exposed to radiation. It is hard to find the clean water and loss source of clean water as Japanese is a Nuclear Power Plant country [15].

The water produced by flood is not clean because it has mixed with another source of water like river, stream, drainage basin, broadsheets of water, creeks, rock and soil that have eroded from mountainsides and also mud, indirectly the water absorb and carry the contaminated along [16]. That's why the water is very harmful to skin as well as to drink it [17-18]. It gives critical to the user because there are lots of dangerous bacteria in flood water which not same as well at the tap water as used before. The health will be affected if use the water from the contaminated flood as the daily use like bathing, cooking, drinking and others [19].

It is important to kill and remove the bacteria before using the water from the flood. Flood will bring the plenty of dirty water instead of clean water and it became the biggest problem during the disaster. It is important to choose the purification and filtration system which effectively eliminate the microorganism in flood water to use for drinking indirectly to overcome the lack of clean water.

In this study, identification of bacteria and its size will find out to ensure the victims of the flood can guarantee safe to drink and use the water. Purification of flood water will be easier by finding or choosing the best ways and techniques after identifying the size of the microorganism to ensure that all bacteria are completely removed and killed. There are many types and technologies nowadays of filtering the dirty water into clean water. Although the result is as expected as it is clear based on physically but has some of them is not guaranteed safe to drink because there are some bacteria still alive. Therefore, the size of the bacteria can identify the best way to treat the water from flood into drinking water.

1.1. Bacteria in Flood Water

Flood water is the most dangerous water, and it is forbidden to use without the right ways. That is because it contains the most and various types of bacteria while it comes from the dirty sources likes human and animal waste, insects and rodents, groundwater, drain and contaminated system. Water from all the sources will mix in flood and contains more bacteria. Bacteria are dangerous and can risk health if it enters into a body. It cannot be detected by smell, sight or taste because of the size and appearance [20]. The dangerous one is waterborne pathogens which supply in floodwater from the human and animal faces [21].

Waterborne pathogens built from two words, waterborne and pathogens which waterborne is a disease which brought by the pathogenic microorganism. The pathogenic is any microorganism whose survival is dependent upon its capacity. A human host is a nutrient-rich, warm, and moist environment, which remains at a uniform temperature and continually renews itself [22]. There are viruses, bacteria, and parasites in the water of flood [23]. Many types of waterborne pathogens, there are Salmonella, Shigella, Vibrio Cholera, Pathogenic E. Coli, Giardia, Cryptosporidium, Rotavirus, Norovirus and Naegleria [24-25]. Mostly they are present in contaminated water and they can present in flood water while all the sources of water become mix into one.

2. Research Methodology

Improving this study need a good understanding while to achieve the aim and overcome the problem during flooding, the survey to the flood area have been performing. This is to identify the management of supplying clean water to the victim including to observe the filtration system used to supply clean water either the system can provide the fully clean water or not.

To overcome the data on this study, a systematic search on the waterborne pathogenic microorganism need to perform. The preliminary research will be carried out through the article, journal, book and document related to the pathogenic and its characteristic including the types, size, disease infected by them. All the data must be related with the proposed research which identifies the size of microorganism in floodwater for filtration purposed. Figure 1 shows the methods used to collect the data and related information to achieve the aim of this study:

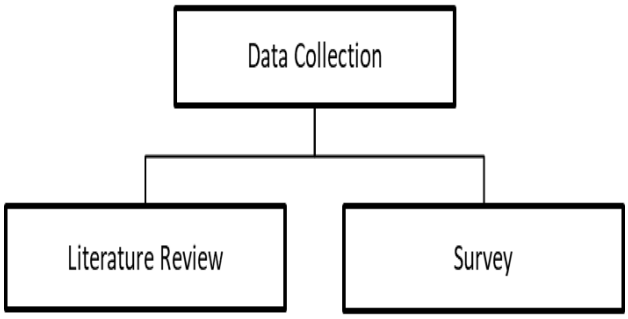
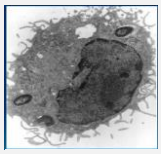
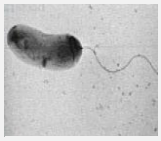
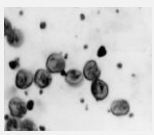
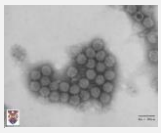


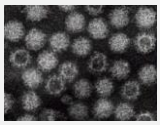
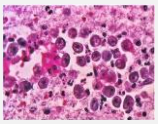
Fig. 1: The Method of Data Collection

3. Results and Discussion

Based on the evaluation in other papers, towards the presence of microorganism in the floodwater, the information has been collected and consolidated under the table as shown in Table 1 and figure 2. This study will be focus on the waterborne pathogenic microorganism covers the types, source of the microorganism, size and the disease brought by them. It is important to identify the waterborne pathogenic for facilitating the process of filtration and sanitation also to avoid from the infections because the presence that can be harmful to the user if not removed.

Table 1: The Waterborne Pathogenic in Floodwater

WATER-BORNE PATHOGENS (BACTERIA)	SOURCE	SIZE	EFFECTS
Salmonella  Wolf-Hall & Nganje,2017 [26]	faecal-oral route and occasionally found in groundwater Primarily foodborne (beef, poultry, milk, eggs), but also transmitted by water [21].	0.7 -1.5 µm width and the length is 2-5 µm [27].	typhoid and diarrheal [28].
Shigella  Marylynn,nd. [29]	Human faeces, transmitted by contaminated food, water, recreation [30].	They are short, gram negative rods, about 2-4 µm in length x 0.6µm in breadth [31].	Gastroenteritis, dysentery, reactive arthritis. [32]. diarrheal (often bloody), fever, cramps, 24--48 hours after infection [33].
Vibrio Cholerae  Marylynn,nd. [29]	Primarily aquatic bacteria. Human faeces and freshwater zooplankton. Transmitted by water and food; rarely by direct contact [24].	0.5- 0.8 µm by 1.5-2.5 µm [34].	Cholera, diarrheal. circulatory collapse and dehydration with cyanosis [35].
Escherichia coli  Marylynn,nd. [29]	Human faeces, the faeces of breast-fed infants. Contaminated food and water as a poor sanitation [36].	It is rod-shaped with 2.5 µm long and 0.8 µm in diameter [37].	Gastroenteritis, Haemolytic Uraemic Syndrome, bloody diarrheal, may cause acute kidney failure, death cause [38].
Giardia Lamblia  Rajkumar, 2014 [39]	Presence in water and animal faeces, contaminated food and water [40].	8 to 12 µm [41].	Giardiasis (chronic gastroenteritis) [24]. Continuous diarrheal, intestinal malabsorption [42].
Cryptosporidium  Marylynn,nd. [29]	Water, human and another mammal faeces, contaminated water and food [43].	Spherical-shape with 4 to 6 microns in diameter [44].	Acute diarrheal, fatal for immunocompromised individuals [28].
Rotavirus  Marylynn,nd. [29]	Human faeces [24].	65 -75 nm in diameter [45].	Gastroenteritis, diarrheal, intestinal enterocytes [46].

Norovirus  (Marylynn,nd. [29]	Human faeces [24]. contaminated food or water [47].	26 to 35-nm [48].	Gastroenteritis, diarrheal, vomiting, abdominal pain, nausea [49].
Naegleria fowleri  Ahmed, 2017 [50]	Fresh water such as rivers and lakes [51].	8 µm to 15 micrometres in size [52].	Headache, fever, nausea and vomiting, encephalitis. Most dead after 1 week of symptom [53].

* µm= micrometre, nm=nanometre

Based on the table above, it tells us the main and dangerous pathogenic presence in the flood water and they are Salmonella, Shigella, Vibrio Cholera, Pathogenic E. Coli, Giardia, Cryptosporidium, Rotavirus, Norovirus and Naegleria fowleri. Most of them bring to diarrhea, fever and some of them can give cramps to the body. It is also can bring to death if continuous using the non-filtered flood water for drinking or cooking.

Based on this study, the size is tiny and cannot be seen by naked eye because of the size between micrometer (10-6) and nanometer (10-9). The figure 2 shows the range of the three types pathogen's size and the protozoa get the first place to be the greater size followed by bacteria with 0.4 to 2.5 micrometre and the last which the smallest placed by viruses with size 20 to 200 nanometre. The pathogenic microorganism shows the biggest one is Naegleria Fowleri with a size of 8 µm to 15 µm and smallest one is Norovirus with 26 nm to 35 nm lengths.

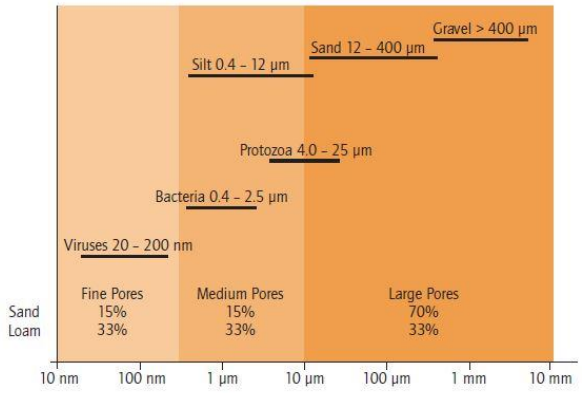


Fig. 2: The Size Range of Pathogens [32]

To ensure the water is clean and safe from the waterborne pathogenic, the filtration system needs to have the pore size below than 20 to 25 nm to ensure all the pathogen including the Norovirus are clear from the water before entering to the body for drinking and cooking.

3.1. Floodwater Quality

Floods could influence water quantity by affecting quality in one of two ways. Floods will either increase contaminants and sediments from urban and agricultural runoff during high rainfall causing a decrease in water quality [54-56]. The drinking water supply will be affected with contamination as the result of the extreme water caused by the weather events [57]. Everybody knows the floodwater is full with contaminants, carry animal waste from fields and forests and it has shown the bacterial count in floodwater is extremely high [58]. Even though it knows, but almost victims use the water for daily use because of the lack of clean water. Once it rises, it will flow to structures and at the same time bringing the disease by an organism. That's why the quality of water producing by the floodwater is the worst one (2013).

As can see, there are two and a half billion people suffer from insufficient access to improved sanitation of water and each year, the world awakened with the more than 1.5 million children die each year from diarrhea diseases [59]. Based on an order by Colorado Department of Public and Health and Environment, there are some rules or safety precaution has been noted while flood coming related to flood water which does not eat or drink in areas near sewage also avoid sewage-contaminated water if possible. That is because the floodwater contains the dangerous bacteria. The victims also have to wash hands well with soap before eating when in contact with flood water or before touching mouth or face [60]. Even hit the water can get diseases, rather than drink the flood water.

Other than that, the flood water or any surrounding area is not safe unless having the local or state authorities have been declared it safe to use especially the clean water tank because of worry if it also contaminated by flood water. In case no safe water for essential use advised boiling the water at least 10 minutes to ensure the quality of water. Also, be alert to chemically contaminated flood water at the industrial site to avoid the chemicals have on the body.

3.2. Wastewater Treatment

There is some treatment has been researched or conducted to purify the floodwater into clean water and safe for drinking or cooking. As been mention at above, there are many bacteria, viruses or parasites in flood water which gives dangerous disease if not carefully using the water. For some nations which expose to flood disaster season, have to get ready with the purification water system to avoid any disease to the victim. One of the treatment is by electrolysis which oxygen ion was used to disinfect water, hydroxyl and hydronium is produced to move the liquid (flood water) from one electrode to another. They will react with it chemically to eliminate the bacteria and turns the floodwater into clean water.

Another treatment has been introduced in Indonesia which faced a lot of potential flood disaster places with clean water problem is MSWT, Mobile Surface Water Treatment. It is such a modular process with a combination of existing technologies and pieces of literature comes in a compact design and equipped with mobile features for easier operational. The technology used is microfiltration (MF) or ultrafiltration (UF) for filtration and followed by UV lamp for disinfection the microorganism. Any mixture or chemical substances utilized in the MSWT. Once have the advantages in otherwise it capacity only around 22kg weight and ideal for the small quantity [61].

Based on the treatment above, electrolysis and MSWT have potential to kill the microorganism also waterborne pathogen because the tool use is capable of removing all the bacteria until the smallest one. Electrolysis is one of the experimental methods to disinfect flood water by using the power supply to generate hydroxyl ion during the container of floodwater is subjected to the electrode plated with nickel. That ion will react chemically to eliminate the bacteria while across the floodwater.

In MSWT, the filtration used such a level by level. Starting with MF which can filter the bacteria with a pore size of 0.1 – 10 µm and only part of the viral contamination is caught up in the process, followed by UF which can remove the particles of 0.001 – 0.1 µm from fluids [62]. The final level which UV light as a system which exposes water to light at just the right wavelength for killing microbes. It's a way to kill bacteria, viruses, fungi, protozoans, and cysts that may be present in the water. The effectiveness of UV treatment depends on the strength and intensity of the light, the amount of time the light shines through the water, and the bill of particles present in the water [63].

4. Conclusion

This paper has discussed the crisis of clean water during flood has inspired to innovate a system of purification based on the size of the waterborne pathogens in the contaminated water to generate clean and safe water to use for drinking water. After the size of the smallest of the pathogen can be detected, it has become a small matter to find the best solution to remove the bacteria and purify the contaminated water. This paper will contribute to solve the problem of water sanitation and avoid many people get an infection from the waterborne pathogenic disease during flood due to water quality control and drinking water treatment.

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