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The Presence of Total Coliform and Fecal Coliform Bacteria in Rainwater Harvesting in Jefara District of Libya

Abdulsalam. I. Rafida, Altaher. Altabet and Ramadan. A.Ghuma

***Abstract*—T**he main objective of this study is to assess the effect of rainfall and surface runoff in contamination of rainwater harvesting, it is collected in underground reservoirs in Jefara District of Libya. The place is used to activate pasture. The water is collected for domestic use and drinking purposes. Samples from (14) reservoirs were collected during winter season and analyzed for the presence of total coliform and fecal coliform. In all samples, total coliforms and fecal coliform were found. A simple unit (reactor) was designed for disinfecting water from total coliform and fecal coliform by heating at a different temperature under continuous fed water. In conclusion non-point source pollution that carried by rainfall and runoff has a significant effect on the presence of bacteria in rainwater harvesting. In addition, effective disinfection of water from total coliform and fecal coliform was achieved at temperature of 50 oC or above. Finally, the unit (reactor) was run at Hydraulic Retention Time (HRT) 2.4 h.

***Keywords*—** Disinfection. fecal coliform. Non-point source pollution. Totall coliforms.

I. Introduction

TOTAL coliform bacteria is the most common pollution in rainfall and runoff water (Hill, *et al* , 2006) . The fecal coliform group is indicative of organisms originating in the intestinal tract of humans and some animals (Thomann and Mueller, 1987). In one of the studies, at Louisiana, that was shown on a river during summer, a strong correlation between high water caused by rain, runoff and increase levels of bacteria (Hill, *et al* , 2006). Another study which was conducted at Finland on rainfall and surface runoff, some samples were collected from pasture area, the results were concluded that the counts fecal coliform increased and being at the highest in rainy and runoff season with which animals were grazed (Uusi-Kamppa, 2005) . Moreover, 156 samples from rainwater harvesting were collected in the Kefalonia Island at Greece and analyzed for the presence of total coliform, bacteria was found in about 120 samples.(Sazakli, *et al*, 2007) Furthermore, efficient disinfection of *E. coli* in water by silver were found with high temperature and pH value. (Qingyun, *et al*, 2008) . In other studies, an indictor was used for solar radiation in disinfection of coliform from contaminated water in rural areas of developing countries (Gondal and Khalil, 2008). Similarly, in one of the experiment disinfection of drinking water by direct heating to temperature of 65 ^{o}C or above, the results were shown to reduce a total coliform in naturally contamination water river(Fjendbo, *et al*, 1998).

Abdulsalam. I. Rafida is with the Tripoli University Faculty of medical Technology, Trioli, Libya (e-mail: Abdulsalam_62Rafida@hotmail.com).

Altaher. Altabet is with the Tripoli University Faculty of medical Technology, Trioli, Libya.

Ramadan. A.Ghuma is with the Department Environment Science and Engineering- Academy of Graduate Studies, Tripoli-Libya.

II. Materials and Methods

A. Study Area

The area of research is located in the north west region of Libya in Jefara district and it is called Bir-Alganm (see Figure 1). The annual rain in the area is 200 to 300 ml per year. Moreover, the area is used to activate pasture and to cultivate some cereal crops. However, rainwater was collected in huge series of underground reservoirs at different volume from 5 m^3 to 41 m^3 (see Figure 2 and Table 1).

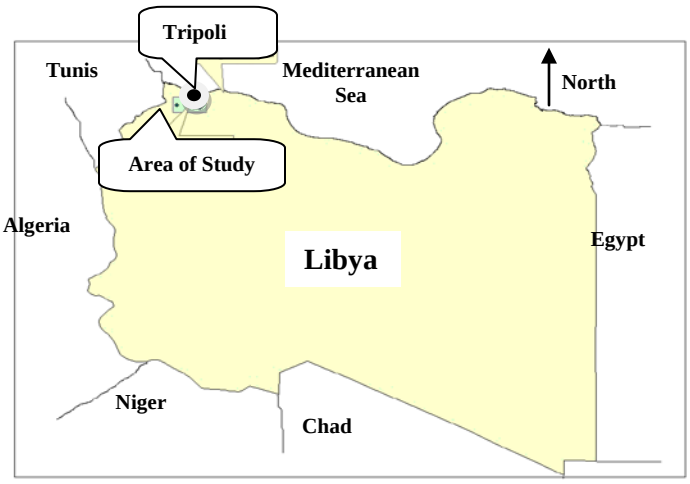

Fig 1: Indicates the study area in Libya

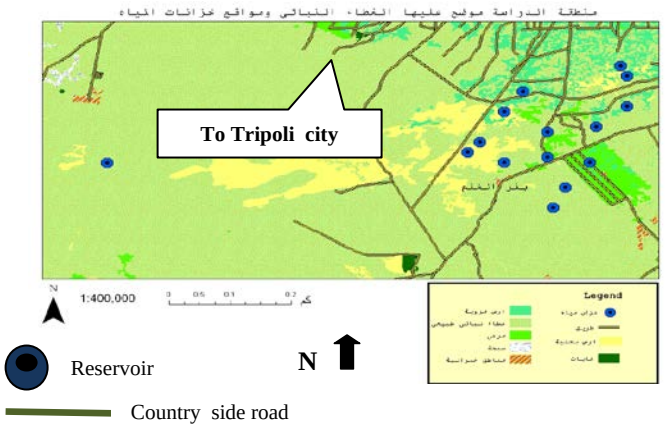

Fig 2: Shows the locations of all the reservoirs in the area of study.

B. Collection of Samples

Water samples were collected in 100 ml plastic bottles from the (14) reservoirs. There after, samples for total Coliform and fecal Coliform were tested.

C. Unit (Reactor) Design

The unit (reactor) was made of metal tube with circular cross section at the length of 10 m and diameter 1.1cm, in order to raise the temperature within the reactor to the operational temperature of 50 C^o or above. The reactor was submerged in water bath with a thermostat to control temperature (see Figure 3). In addition, the unit (reactor) was run at Hydraulic Retention Time (HRT) 2.4 h.

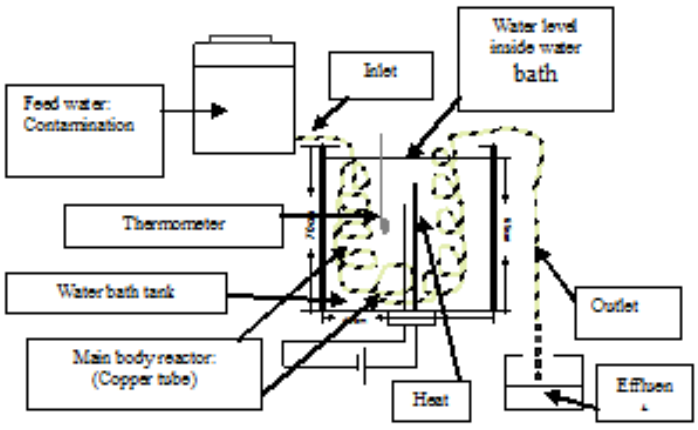

Fig 3 Schematic diagram of the cross-section of propose reactor.

D. Operation of the unit (Reactor)

The unit (reactor) was operated under continuous fed water (NB:used water from reservoirs which contamination was tested with a total coliform and fecal coliform (Table 1). The unit (reactor) was at pH value three states natural, four acid and ten bases. To get these condition a normal water from reservoirs, a drop of concentrated nitric acid (HNO_3, 65%) and some drop from solution (NaOH 5%) was added respectively. The reactor was run at different temperature (25, 50, 60, 70 and 75C^o ± 3). Moreover, four water samples were collected after water treatment every day.

E. Analytical Techniques

1. Total Coliform Count

100 ml of water samples were filtered into a membrane filter using a sterile filtration unit. After filtration, forceps were used to place the membrane filter on M-Endo Broth in invert plate. The plate was then incubated in an incubator at a temperature of 45 ^oC for 24h. The plates were then checked for bacteria colony growth.

2. Fecal Coliform Count

The same method was followed in total coliform count but after filtration, forceps were used to place the membrane filter on an MEC Broth in invert plate and the plate was then incubated in an incubator at a temperature of 37 ^oC for 24h. Growing bacteria colony was the checked for growth.

III. Results and Discussion

A. Microbes Indicator in Water from Reservoirs

Table (1) shows the presence of the all microbes indicator (total coliform and fecal coliform) which was observed in all the reservoirs. The present results shows that all microbes indicator are found in all reservoirs except fecal coliform found only in reservoirs number 7 and 11. However, this contamination may referr to collected samples from reservoirs directly after rainfall and effect type of surface collect. These results agree with Uusi-Kamppa (2005) who concluded, that microbes indicator may enter surface water from runoff pastures area with permeable soils.

TABLE I
SHOWS VOLUME OF RESERVOIRS, TOTAL COLIFORM AND FECAL COLIFORM IN ALL THE RESERVOIRS.

NO of reservoir	Volume 0f reservoir (m^3)	Type of surface collect	Total coliform	Total coliform
1	10	RS+RHW	+	+
2	10	RS	+	+
3	10	RS	+	+
4	15	RHW	+	+
5	17	RS	+	+
6	21	RSP	+	+
7	21	RS	+	-
8	24	RSP	+	+
9	26	RS	+	+
10	30	RS+RHW	+	+
11	31	RS	+	-
12	35	RS+RHW	+	+
13	41	RSP	+	+
14	41	RS	+	+

+ bacteria present, - bacteria absent, RS: Runoff from Soil surface, RHW: Runoff from Highway, RSP: Runoff from

Soil surface in Pasture area.

B. Microbes Indicator in Water After Treatment.

Table (2, 3 and 4) shows all the microbes indicator (total coliform and fecal coliform) in the treatment of water obtained from reactor at different pH values (4, 7.3 and 10) and temperature (50, 60, 70 and 75^{o}C ± 3). All the microbes indicator was presented in water before treatment (see at temperature 25 ^{o}C). However, from the results, a microbes indicator was presented in the water after treatment in reactor at temperature (50 ^{o}C ± 3) with pH values bases (7.3 and 10), was compared to pH value acid (4), was disappeared at same temperature (50 ^{o}C ± 3). On the other hand, results were obtained at increased temperature within reactor to (60, 70 and 75C^{o} ± 3), all the pH values were tested (4, 7.3 and 10), it was observed that all microbes indicator was disappeared. These results seem to be consistent with the result of Elkarmi *et al*, (2008) who reduced more than 99% Colifrm bacteria from drinking water by using natural solar radiation and UV lamp of of 365 nm wavelengths in which the reactor was made from (PVC).

TABLE II
SHOWS OBSERVED INDICATOR MICROBES (TOTAL COLIFORM AND FECAL COLIFORM) AFTER TREATMENT WATER IN REACTOR AT ACID PH WITH DIFFERENT TEMPERATURE.

Temperature ^{o}C	pH	Total coliform CUF/100 ml*	Fecal coliform CUF/100 ml*
25	4	40	25
50	4	0	0
60	4	0	0
70	4	0	0
75	4	0	0

TABLE III
SHOWS OBSERVED INDICATOR MICROBES (TOTAL COLIFORM AND FECAL COLIFORM) AFTER TREATMENT WATER IN REACTOR AT NATURAL PH 7.3 WITH DIFFERENT TEMPERATURE.

Temperature ^{o}C	pH	Total coliform CUF/100 ml*	Fecal coliform CUF/100 ml*
25	7.3	133	91
50	7.3	79	37
60	7.3	0	0
70	7.3	0	0
75	7.3	0	0

TABLE IV
SHOWS OBSERVED INDICATOR MICROBES (TOTAL COLIFORM AND FECAL COLIFORM) AFTER TREATMENT WATER IN REACTOR AT BASES PH WITH DIFFERENT TEMPERATURE.

Temperature ^{o}C	pH	Total coliform CUF/100 ml*	Fecal coliform CUF/100 ml*
25	10	23	10
50	10	15	6
60	10	0	0
70	10	0	0
75	10	0	0

IV. CONCLUSION

All rainwater samples were contaminated with Total Coliform and Fecal Coliform bacteria. But, the success of process of disinfection rainwater collected when heated at a temperature of 50 ^{o}C or above, within reactor designed in the experiment.

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