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Research On The Model To Treat Iron In Underground Water Tank In Ban Ngoai Commune, Dai Tu District, Thai Nguyen Province

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***Abstract*—The research has shown that the iron content in underground water in Ban Ngoai commune has exceeded the standard amount allowed by Ministry of Health, according to QCVN 02:2009/BYT, from 3,753 to 7,440 times. The research on developing a model to treat iron in underground water by using filter tank has shown that with the effectiveness of water treatment is different, depending on the treatment time and material length: original iron content was 2,232 mg/l decreased to 0,456 mg/l for formula 1, and that for formular 2 is 0,816 mg/l, Formula 3 is 0,182 mg/l, formula 4 is 0,534 mg/l, formula 5 is 0,872 mg/l. F5 was least effective with the final iron content was 0,872mg/l, F3 was most effective with the final iron content was 0,182 mg/l which is lower than the standard and water is quality is enough to be used for daily use.**

Keywords—domestic wastewater, iron, treatment

1. RATIONALE

Water is an essential factor of every creature. Without it, nothing can survive and breed. In industry, water is considered as an unreplaceable resource in manufacture[5].In some rural areas, villagers still use underground water in their daily life since the spread of “Bring clean water and Improve hygiene in rural area” program has not yet reached them. However, underground water contains iron element in forms of dissolved salt or complex substancesdue to dissolution from mineral deposits in the rock or from surface contamination by wastewater [2]. In addition, iron in underground water usually presents in ionic form, Fe2+ salthas valence (II) is a component of dissolved salts: Fe(HCO3)2, FeSO4....Iron normally has a high fraction and being unevenly distributed in deep rock sediments [1]

According to the World Health Organization, 80% of the disease in developing countries is related to water and the environment. And in Vietnam, there are 9,000 deaths each year, and 200,000 people with cancer; the main cause of which is water pollution, typically the source of water contaminated by iron. The problem of water not only causes difficulty and inconvenience in daily activities for the people but also has serious consequences to the health of consumers [3].

II. OBJECTIVES AND METHODOLOGY

- Objectives

- To evaluate iron fractioning underground water in some areas in Ban Ngoai commune.

- Study on the treatment of iron in underground water by filter tanks.

- *Methodology*
- ***Methods of collecting water samples***

+ TCVN 6663-3:2008 (ISO 5667-3:2003) – Water quality – Collecting samples.Guidelines for preservation and processing samples.

+ TCVN 6000-1995 (ISO 5667 -11: 1992) - Water quality – Collecting samples. Guidelines for collecting underground water samples.

Table 1: Water sampling location

Sample	Symbols	Location	Sampling standards
Underground water	NN	At the household wells of Mr.Le Duy Thai, Ham Bang village	ISO 5667 – 11:1992 TCVN 6000 – 1995. Guidelines for collecting underground water samples.
	NN1	In theself-constructedfiltered faucet of Mr. Vu Van Thang, Ba Giang village	Pick up directly at the hose
	NN2	In theself-constructedfiltered faucet of Mr. Dinh Xuan Tho, Le Loi village	Pick up directly at the hose
	NN3	In theself-constructedfiltered faucet of Mr. Tran Van Vinh, Khau Giang village	Pick up directly at the hose

- ***Methods of data analysis***

- pH is measured directly with pH meter

- Fe^{+2}analyzed by colorimetric method

- Total iron is determined by ASS

- ***Methods of experimental arrangement***

Materials: The experimental model includes a PVC rain shower; a plastic filter tank with a capacity of about 250 liters of water, a height of about 1.2 meters, the bottom side with a tap water filtered water tank; The upper side has a tap on the iron alum; At the bottom of the tank there is a water pipe drilled 0.5 cm; Filter materials include: Quartz sand, activated carbon, manganese sand, small gravel, large gravel; a tank, bucket or water tank that has been treated.

Experimental layout:

Study the model of iron treatment in ground water with 5 different thickness formulas of filter materials:

Table 2. Thickness of filter material according to different formulas

Materials	Thickness of filter material (cm)				
	Formula 1 (CT1)	***Formula 2 (CT2)***	***Formula 3 (CT3)***	***Formula 4 (CT4)***	***Formula 5 (CT5)***
Quartz sand	30	20	30	30	20
Activated carbon	30	20	30	25	15
Manganese sand	10	5	10	15	10
Small gravel	5	10	10	15	15
Large gravel	20	30	30	20	30

Conditions for conducting the experiment*:*

- Make sure the total thickness of the layers is 50cm or more.

- The bottom layer is the gravel to create a space for collecting water. Followed by layers of activated carbon andmanganese sand. Use as small particles of coal as possible to absorb odors, colors and chemical solvents. On top is a layer of quartz sand and irony smell. At the same time, this filter must always be submerged to maintain smooth layers between the materials.

- Ensuring oxygen for catalytic reduction of iron occurs.

* Each sample will be repeated 3 times to ensure the basis for statistical processing.

- ***Data processing***

- Utilize Excel software and statistical software SPSS v22.2.

III. RESULTS AND DISCUSSION

3.1. Evaluation of iron content in undergroundwater in some areas of Ban Ngoai Commune

Results of undergroundwater sampling and monitoring in Ban Non Commune are shown in Table 3.

Table 3: Results of experimental analysis

Parameters	Unit	Samples				QCVN 01:2009/BYT
		NN	NN1	NN2	NN3	
pH	-	6,44	6,55	6,49	6,57	6,5-8,5
Fe^{2+}	mg/l	2,120	1,121	1,135	1,128	-
Fe^{3+}	mg/l	0,112	0,039	0,186	0,098	-
Total iron	mg/l	2,232	1,160	1,321	1,226	0,3

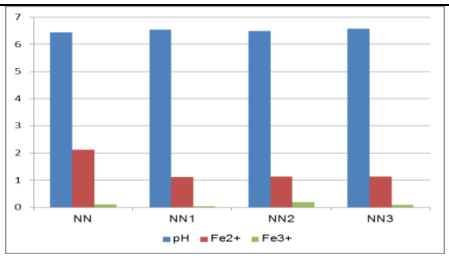

Figure 1: Iron content in Ban Ngoai commune

The data sheet and analysis results show that the pH is within the allowed standard, but the underground water source is infected iron with the total iron content is way much higher than Vietnam standard (QCVN) 01: 2009 / BYT. Water samples NN had the highest Fe content of 7.440 times, NN1 was 3.867 times higher, NN2 was 4.403 times and NN3 was 3.753 times compared to QCVN. As a result, the water source is not ensured, so it will affect the use of drinking water.

3.2. Study on the model of iron treatment in underground water

Evaluation of the iron treatment efficiency through 5 formulations with different thicknesses of filter materials show that: water quality after filtration depends on the ratio and composition of the filter material. Therefore, depending on the effect of each type of filter materials, the thickness of the filter materials is changed to create a certain effect.

3.2.1. The efficiency of treating iron in groundwater by filtration tank

Table 4. Fe content after consecutive filtration

Formula	Experimental time			
	Initial day	5 days	8days	10 days
pH				
CT1	6,44	$6,633\pm 0,0152^{d}$	$6,726\pm0,152^{c}$	$6,776\pm0,015^{c}$
CT2	6,44	$6,493\pm 0,0152^{b}$	$6,530\pm0,026^{a}$	$6,539\pm0,015^{a}$
CT3	6,44	$6,860\pm 0,0100^{e}$	$6,933\pm0,005^{d}$	$6,970\pm0,010^{d}$
CT4	6,44	$6,526\pm 0,0152^{c}$	$6,570\pm0,010^{b}$	$6,620\pm0,010^{b}$
CT5	6,44	$6,463\pm 0,0152^{a}$	$6,523\pm0,005^{a}$	$6,550\pm0,010^{a}$
Total Fe				
CT1	2,232	$0,544\pm0,001^{b}$	$0,463\pm0,001^{b}$	$0,456\pm0,001^{b}$
CT2	2,232	$0,938\pm0,002^{d}$	$0,829\pm0,001^{d}$	$0,816\pm0,0015^{d}$
CT3	2,232	$0,255\pm0,001^{a}$	$0,193\pm0,001^{a}$	$0,182\pm0,001^{a}$
CT4	2,232	$0,826\pm0,001^{c}$	$0,591\pm0,002^{c}$	$0,534\pm0,0015^{c}$
CT5	2,232	$1,163\pm0,002^{e}$	$0,915\pm0,001^{e}$	$0,872\pm0,0015^{d}$
Sig		0,000	0,000	0,000

(Note:a, b, c, d, ein the vertical column in each of the different experiments means 5%, Duncan's test) (Source: Analysis data in 2018)

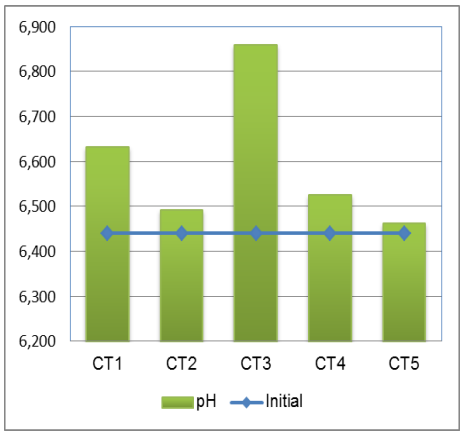

Figure3.2.a. pH after 5 days

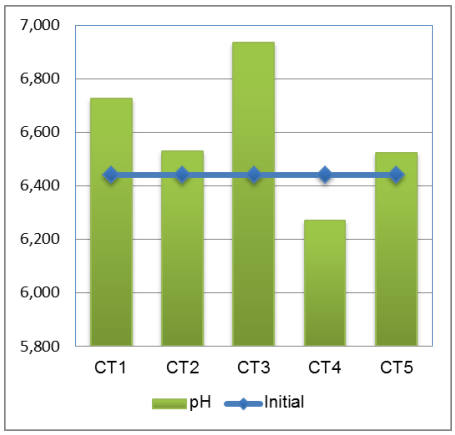

Figure 3.2.b. pH after 8 days

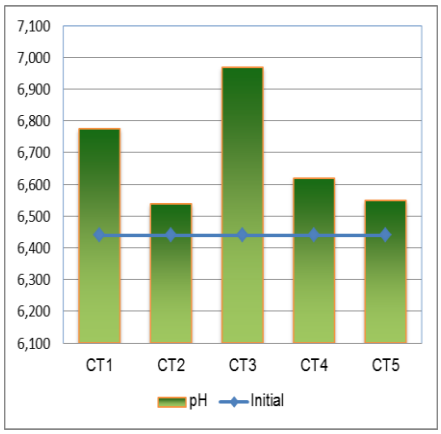

Figure 3.2.c. pH after 10 days

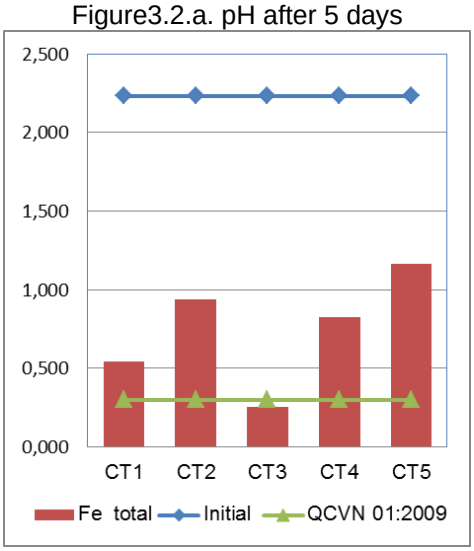

Figure 3.2.d. Iron content after 5 days

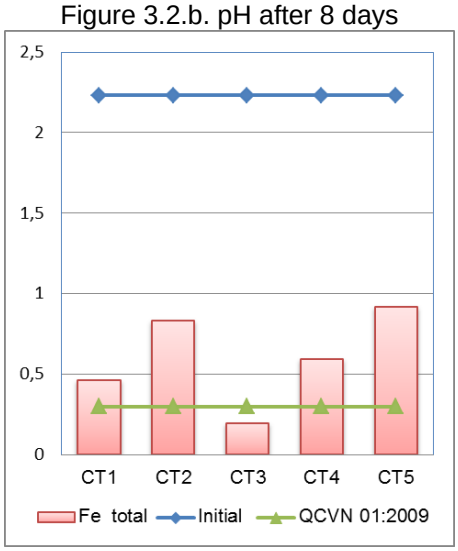

Figure 3.2.e. Iron content after 8days

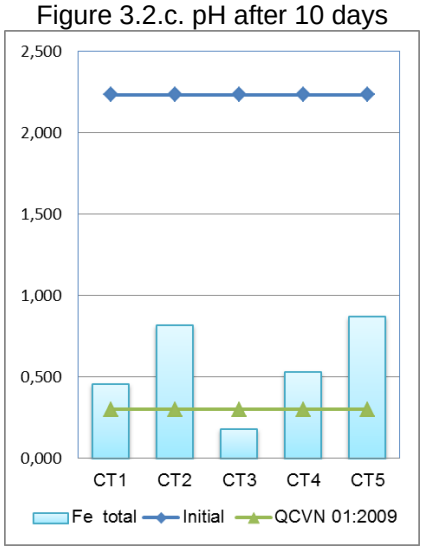

Figure 3.2.f. Iron content after10days

Figure 2: pH and iron content after filtration

From table 4 and figure 2 showed that:

+ After 5 days of continuous water filtration, the results of the analysis showed that the filter efficiency was significantly different (Sig = 0.000 <0.05). Formula for best model performance was CT3 with iron content of 0.255mg/l with pH = 6.860 and the worst filtration efficiency was formula CT5, CT2 with treated iron content of 1.163 mg/l The 0.938 mg/l. In comparison with QCVN 01: 2009/BYT, CT3 was satisfied the standard, while the remaining formula exceeded the iron level, especially CT5 was 3.877 times higher.

+ After 8 days of continuous filtration, the results of the analysis showed that the filter efficiency of the formula was significant(Sig = 0.000 <0.05). In particular, Fe content in water before processing was 2.232 mg/l, Fe content continued to decrease, for CT1 decreased 4.820 times with pH = 6,726, CT2 decreased 2,692 times, pH = 6,530; CT3 decreased 11,565 times, pH = 6,933; CT4 decreased 3,776 times, pH = 6,570; CT43 decreased 2,439 times and pH = 6,523. Compared with QCVN 01: 2009/BYT after 8 days of continuous filtration, the highest filter efficiency is CT3 0.193mg/l with pH = 6.933 mean below the allowable standard, the remaining formula Fe content output still exceeds The highest is CT5 and CT2. The treatment efficiency of Fe in the next 3 days of filtration increased compared to the first 5 days of filtration, the material after a period of 8 days continuously filtered to achieve the effect of iron content continue to decrease, CT3 is the formula reached Highest performance compared to the rest of the formula.

+ After 10 days of continuous filtration, the effect of iron treatment on CT3 model was highest, namely: The initial iron content was 2,232 mg/l reduced to 0.456 mg/l for formula 1, the second formula was 0.816 mg / Formula 3 is 0.182 mg/l, formula 4 is 0.534 mg/l, formula 5 is 0.872 mg/l. In comparison with Vietnamese standard 01: 2009 of the Ministry of Health, the iron content is treated in the form of standard formula 3. From the results above, the effect of Fe and pH treatment on filter days show the stability over time. The Fe content decreased gradually and pH increasedafter treatments. During 8 days, the iron content decreased significantly, especially CT4, CT5, by day 10 the iron content was stable due to the Fe content was not much lower than the 8 days filtered before. After 10 days of filtration, Fe treatment was highest and CT3 was effective formula; CT5 was ineffective formula. According to the Ministry of Health's drinking water standard QCVN 02: 2009/BYT, the total permissible concentration of iron in the water is 0.3

mg/l. When compared with the total iron concentration after treated by the filter formula, it can be seen that the filter formula sorted by the formula 1,2,4,5 exceeds the allowed standard, only the third filter function met iron standards. Therefore, authors recommend people in Ban Ngoai commune, Dai Tu district to utilize the above formula.

IV. CONCLUSION

Based on the research results, the ground water quality in Ban Ngoai commune has the iron content exceeding 3,753 to 7,440 times.

After 10 days of continuous filtration, the initial iron content of 2,232 mg/l was reduced to 0.456 mg/l for formula 1, 0.816 mg/l for formulation 2, 0.134 mg/l for formula 3, 0.534 mg/l, formula 5 is 0.872 mg/l. CT5 had the lowest efficiency with Fe content of 0.872 mg/l, CT3 achieved the highest Fe content of 0.182mg/l, iron content was lower than standard and water quality was safe to use for living purposes. CT3 was the formula with the most effective model, the formula was applied in practice with the thickness of 30cm quartz sand, activated charcoal 30cm, manganese sand 10cm, small gravel 10cm, large gravel 30 cm.

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