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An investigation of the parameters impacting pressurized sand filter efficiency in rural fresh water refinery in an Urban Area (Case study: Almassi Refinery in Sheiban County)

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ABSTRACT

The motivation for doing this research project was the unsatisfactory quality of exit water in Sheiban County Shahid Almassi rural water refinery. The aim was to discover the optimal combination of coagulating materials. Three coagulated materials were tested. Changes were made in the depth and structure of the filter bed grain formations to find the optimal levels and structures, and so were their surface loadings in five different combinations. Two physical models for evaluating the biological, chemical and physical parameters related to the filters were constructed. Samples were taken at five points in the water refinery (both before and after the under pressure sand filters). The results show that the optimal choice is to use perlite and Anthracite simultaneously in bed filters with 66% surface load, using Poly Aluminum Chloride in the coagulation step.

1. Introduction

Water resource scarcity is a great problem attended by experts, decision-makers and managers of our country (Heydari et al., 2014). The chemical and physical parameters of water are very important and significant for assessing and classifying water quality. The water demand for agricultural, industrial and domestic uses increases as the population increases, too (Heydari and Nouri-Bidgoli, 2014).

According to the WHO (2003), drinking water must be free of chemicals and microbial contaminations which are risky to human health (Heydari and Nouri-Bidgoli, 2014). For the human health, drinking water with high quality is essential and important. Very important for public health is water analysis for physical and chemical properties including trace element contents (Anonymous, 1992).

Processes, being used for fresh water refineries, depend on water provision resource quality.

There are a number of problems to be dealt with. First, the surface waters ordinarily hold more variations of contaminators than subterranean waters, so refinery processes may be complex for such waters. Second, a high proportion of surface waters are high in turbidity -above the determined quantity by the fresh water standards. Third, although the water currents are moving very fast, they may have greater matter in suspended manner. On the other hand, a lot of solids are in chloidic sizes. As a result, the chemical coagulation and filtration functions are needed for separating them.

The fresh water of Ahvaz and its surrounding villages is secured from the surface water of the Khozestan plain, especially from Karoon and Karkheh rivers. The unsatisfactory quality of the water forced officials to exploit fresh water for 91 villages of central Ahvazian part by establishing Sheiban Shahid Almassi water refinery in Ahvaz city on the bank of Karoon River in 2007. This study aimed to investigate the factors that affect under pressure sand filter efficiency. The result may help to use physical, chemical and biological parameters to decrease the turbidity of freshwater, filtration speed equilibrium, disinfection expense, and repair and maintenance expense of under pressure sand filters. The researchers also measured the changes in bed and surface load of under pressure sand filters for elevation of the exit water. The factors under study play a major role equipping the rural refinery's laboratories and employing experts in them.

2. Materials and methods

2.1. Shahid Almassi water refinery

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Shahid Almassi Fresh Water Refinery is located on (31º, 25’, 10"N and 48º, 47’, 21"E) and a height above 14m from the sea level, along Karoon River on Koot Seied Enayat village. It can refine 400 m^3/h with a productive pure water rate 9600 m^3/d. The units of the refinery include dock of basin, primary pre-sediment pool equipped with mud-sweeping bridge, speed mixture pool, particle and limpid forming suction pool of limpid forming, suction pumping station from limpid forming, under pressure sand filters, washing filter pumping station, 2000m^3 pure water tanks and other sections responsible for mixing chloride, injecting coagulating matter, generating electricity, as well as, units assigned as transformer, reservoir, laboratory, staff and maintenance.

In this water refinery, after going through primarily sedimentation and coagulation (clot forming, limpid forming) water reaches the under pressure sand filters and flows through transmitting lines in order for the dis-infective operation to take place. A number of devices are currently non-operational due to technical failures, causing problems for coagulating matter injection, particle forming and limpid forming. Sheiban Shahid Almassi Fresh Water Refinery has four under pressure sand filter devices, including a horizontal cylinder metal tank with a cut level diameter 2.5m and a 9m length. The capacity of each of the filters is 200m^3/h, with 18m^2 effective levels and a 55litre refining ability of limpid water in a second (Fig. 1).

Fig. 1: Under pressure sand filters in the refinery

The applied material structure in bed of available under pressure sand filters in the water refinery from up to down is as follows: silicium with a 0.5 to 1.2mm, 60cm seed forming- Silicium with a 2 to 4 mm, 15cm seed forming- silicium with a 5 to 8mm, 15cm seed forming- silicium with 8 to 12mm, 20cm seed forming.

2.2. Under pressure sand filter model

Since changing the entire material of an under pressure sand filter is very expensive, only one element of the under pressure sand filter was utilized for the research purpose. Two devices of an under pressure filter model were constructed for changing seed forming; in addition, perlite, anthracite and the different level load in these filters were used in the research (Fig. 2).

Each model was constructed with a 2m galvanized pipe with a 6 inch diameter. Water flowed through a 0.5inch polyethylene pipe. A water counter measured the amount of water. A cut and joint valve was used to control the amount of water exit. A water distributor was used to distribute arrival water on the bed surface. A barometer was installed to measure water pressure level entering to the system. A counter was installed to measure exit water. The two under pressure sand filter models were fed by the water entering the system. Under pressure sand filters are made of metal tripods holding the bed board in a 6 inch pipe. The model bed board, instead of nozzle, has multiple holes. Also, it is covered by a plastic reticular board, and the bed materials are placed on it. In this research, the inversed washing filters were not used in construction of this model.

Fig. 2: Model of under pressure sand filters

2.3. Evaluation of important parameters in under-pressure sand filters

Before doing the research, biological, chemical and physical parameters were evaluated and some of those related to under pressure sand filters were chosen. The evaluated parameters are as follows: a) physical parameters including temperature, turbidity, solution matter (TDS), suspended matter (TSS), total solid matter (TS), and electrical guidance; b) chemical parameters including total solidity, total alkalify, calcium rate, magnesium, aluminum, and PH; and c) biological parameters including Total coliforms rate and fecal Coliform rate. The test was carried out in the central laboratory of refinery No.2 of the Ahvaz City. The following tools were used: Jar test device VELP Scientific model JLT6, Turbid meter model 2100N, OVE , Dedicator, Digital balance Sartorius model BL210S, Diaphragm Vacuum pressure pump model BF-S2500, Ban Mary device , EC meter device model WTW, Digital burette, digital PH meter device, Hot plate device model 1103 (JENWAY), Spectrophotometer device model DR5000, Incubator, Diluting water dishes, Gauge balloon, Pipet, Degreed Cylinder bescher, Magnet, Filter paper, Clock glass, Piset, Distilled water, Tampon, Eriophorum Black T introducer (EBT), EDTA 0.01 molar, Sodium 1 normal monoxide introducer, Chloridric acid, Amin hydroxide, Ammonium Acetate phenanthroline, Sulfuric acid, Sodium acetate and eriochrome cyanine introducer. The standardized alcohols, shaker and digital balance were used to examine the monotony coefficient rate. The under pressure sand filter bed material (silicium and perlite and anthracite) was made in Ahvaz Azad University soil mechanical lab.

3. Research procedure

Step 1

First, the following preliminary steps were taken: Pre-sediment pools were observed. The sweeping mud operations were recorded. Clot and Limpid formations were recorded, too. Fixations on the pre-sediment and limpid forming pool, and sweeping Mud Bridge were also recorded. Samples were taken of mixers of clot making pool of water entering to the refinery at the following points: (A), arrival water to filter (B), initial exit water from filter (C) and (D) function of filter before water arrives at the washing filter (E). No coagulator material was added to the water load of filters $12m^3/hr/m^2$. Then, the intended physical, chemical and biological tests were carried out on five samples while the water entering the system and exit water were controlled and, so was consumed chloride rate from the filter. Table 1 shows the results of laboratorial data. The quality of the exit water from the under pressure sand filters in this step was unsatisfactory- below international standards.

Table 1: The results obtained from different physical, chemical and biological tests on 5 samples of water in step 1

Date of test : May.08.2010	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Fresh Water Standard	
							Max admit	Max desired
Total solids (TS)	mg/lit	911	766	749	740	736	-	-
Total suspended solids (TSS)	mg/lit	236	111	104	101	99	-	-
Total solution solids (TDS)	mg/lit	675	655	645	639	637	2000	500
Turbidity	NTU	178	107	100	96	93	5	1
Electric Guidance (EC)	µsem/cm	1070	1032	1032	1029	1027	2000	1500
Hydrogen ion viscosity (PH)	-	7.97	8.01	8.03	8.03	8.04	6.5-9.2	7-8.5
Temperature	ºC	19.3	19.9	19.9	19.7	19.5	-	-
Total alkalify	mg/lit	178	161.8	158	158	155.4	-	-
Calcium	mg/lit	84.85	84.21	82.28	81.84	81.21	200	75
Magnesium	mg/lit	19.53	18.96	19.05	18.86	18.96	150	50
Total Hardness	mg/lit	293.63	289.68	285.73	283.35	282.17	500	150
Iron (Ferro)	mg/lit	0	0	0	0	0	1	0.3
Aluminum	mg/lit	0	0	0	0	0	0.5	0.1
Total coliforms	-	24000	9300	4300	4300	0	0	0
Fecal coliforms	-	4300	910	910	910	0	0	0
Arrival water to filter	m^3/hr	220						
Exit water to filter in the start	m^3/hr	220						
Exit water to filter in the end	m^3/hr	198						
Time of function filter	hr	21						
Consumed chloride for disinfection	kg/hr	5						

Step 2: Use of the Best Coagulator Material

In this step, the coagulator matter, namely, solid Poly Aluminum Chloride (PAC), Liquid Poly Aluminum Chloride (PACL), and Ferric Chloride (Cl_3Fe) were measured with respect to the Jar test. The PAC is the best coagulator material and has the best injection quantity when coagulation operation is 6ppm.A few hours later; samples were taken at the following points: (A), arrival water to filter (B), initial exit water from filter (C) and (D) function of filter before water arrives at the washing filter (E). No coagulator material was added to the water load of filters 12m^3/hr/m^2. In this case, the level load quantity 12 m^3/hr/m^2 was obtained. Then, the pre-planned physical, chemical and biological tests were carried out on five samples, while the water entering the system as well as exit water, exit water from filter and consumed chloride rate were controlled and, so was consumed chloride rate from the filter. Table 2 shows the results of laboratorial data.

Table 2: The results obtained from different physical, chemical and biological tests on 5 samples of water in step 2

Date of test : May.30.2010	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Fresh Water Standard	
							Max admit	Max desired
Total solids (TS)	mg/lit	1356	1235	1193	1172	1151	-	-
Total suspended solids (TSS)	mg/lit	173	67	47	43	36	-	-
Total solution solids (TDS)	mg/lit	1183	1168	1146	1129	1115	2000	500
Turbidity	NTU	132	51	34	31	26	5	1
Electric Guidance (EC)	µsem/cm	2006	1953	1948	1891	1858	2000	1500
Hydrogen ion viscosity (PH)	-	8.07	8.11	8.08	8.08	8.06	6.5-9.2	7-8.5
Temperature	ºC	17.8	17.3	17.6	17.7	17.8	-	-
Total alkalify	mg/lit	186.8	177.2	174.4	173.4	172.2	-	-
Calcium	mg/lit	138.15	136.56	134.18	131.80	129.10	200	75
Magnesium	mg/lit	44.74	44.26	40.93	41.03	41.03	150	50
Total Hardness	mg/lit	531.71	525.76	505.92	500.36	493.61	500	150
Iron (Ferro)	mg/lit	0	0	0	0	0	1	0.3
Aluminum	mg/lit	0	0	0	0	0	0.5	0.1
Total coliforms	-	4300	2300	930	930	0	0	0
Fecal coliforms	-	4300	2300	210	210	0	0	0
Arrival water to filter	m^3/hr	220						
Exit water to filter in the start	m^3/hr	220						
Exit water to filter in the end	m^3/hr	195						
Time of function filter	hr	27						
Consumed chloride for disinfection	kg/hr	3.5						

Step 3: Change in Type and Height of the Bed Materials (Silicium and Anthracite)

In this step, a change was made in the height of bed material layers of the under pressure sand filter model, while the total layer heights and the small grain layers were controlled in the under pressure sand filter model. The changes in the bed layers are as follows: Selenium with grain forming 0.5-1.2mm, 45cm; Anthracite with grain forming 2-4mm, 40cm; Selenium with grain forming 5-8mm , 15cm; Silicium with grain forming 8-12mm, 20cm. Larger grain formations in the lower part and smaller grain formations in the upper part of under pressure sand filter bed were used. The level load was also equal to lit/min 3.7(12 m^3/hr/m^2 in the available filters in the refinery). Samples were taken at the points A, B, C, D and E. Then, the pre-planned physical, chemical and biological tests were carried out on five samples while the arrival and exit water and exit rate were controlled, and so was consumed chloride rate from the filter. Table 3 shows the results.

Step 4: Change in Type and Height of the Bed Materials (Silicium and Anthracite) and Surface Load Decrease

In this step, the under pressure sand model bed grain formations was recorded as in step three. The surface load was the same as the ones in steps two and three in previous step surface loads, which was equal to 2.5 lit/min (8 m^3/hr/m^2 in the available filters in the refinery). After making changes in grain formation and surface loads, Samples were taken at the points A, B, C, D and E. Then, the intended physical, chemical and biological tests were carried out on five samples, while the arrival and exit water and water exit rate from the filter were controlled, and so was consumed chloride rate from the filter. Table 4 shows the results.

Step 5: Change in Type and Height of the Bed Materials (Silicium and Anthracite)

In this step, the perlite and anthracite were added as filter bed material. In this case, perlite and anthracite were added from up to down respectively:

Perlite with grain forming 0.5-2 mm, 45 cm-Anthracite with grain forming 2-4 mm, 40 cm-Perlite with grain forming 4-6 mm, 15 cm and Perlite with grain forming 6-8 mm, 20 cm.

Table 3: The results obtained from different physical, chemical and biological tests on 5 samples of water in step 3

Date of test : June.13.2010	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Fresh Water Standard	
							Max admit	Max desired
Total solids (TS)	mg/lit	1106	965	819	815	812	-	-
Total suspended solids (TSS)	mg/lit	258	144	47	46	46	-	-
Total solution solids (TDS)	mg/lit	848	821	772	769	766	2000	500
Turbidity	NTU	117.4	64.6	15.1	14.3	14.3	5	1
Electric Guidance (EC)	µsem/cm	1574	1553	1470	1476	1472	2000	1500
Hydrogen ion viscosity (PH)	-	7.97	7.81	7.91	7.80	7.93	6.5-9.2	7-8.5
Temperature	ºC	26.4	26	25.2	25.3	24.9	-	-
Total alkalify	mg/lit	148.8	148	144.8	139	138	-	-
Calcium	mg/lit	95.83	93.85	92.90	92.90	86.56	200	75
Magnesium	mg/lit	29.35	29.68	24.17	25.60	24.70	150	50
Total Hardness	mg/lit	361.94	358.38	333.03	338.97	336.20	500	150
Iron (Ferro)	mg/lit	0	0	0	0	0	1	0.3
Aluminum	mg/lit	0	0	0	0	0	0.5	0.1
Total coliforms	-	910	30	0	0	0	0	0
Fecal coliforms	-	910	30	0	0	0	0	0
Arrival water to filter	m^3/hr	220						
Exit water to filter in the start	m^3/hr	220						
Exit water to filter in the end	m^3/hr	192						
Time of function filter	hr	30						
Consumed chloride for disinfection	kg/hr	3						

Table 4: The results obtained from different physical, chemical and biological tests on 5 samples of water in step 4

Date of test : June.13.2010	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Fresh Water Standard	
							Max admit	Max desired
Total solids (TS)	mg/lit	1106	965	782	764	765	-	-
Total suspended solids (TSS)	mg/lit	258	144	22	20	21	-	-
Total solution solids (TDS)	mg/lit	848	821	760	744	744	2000	500
Turbidity	NTU	117.4	64.6	6.4	5.7	5.7	5	1
Electric Guidance (EC)	µsem/cm	1574	1553	1433	1429	1430	2000	1500
Hydrogen ion viscosity (PH)	-	7.97	7.81	7.77	7.79	7.76	6.5-9.2	7-8.5
Temperature	ºC	26.4	26	25.8	25.3	25.5	-	-
Total alkalify	mg/lit	148.8	148	138.4	137.4	137.2	-	-
Calcium	mg/lit	95.83	93.85	89.1	88.62	88.78	200	75
Magnesium	mg/lit	29.35	29.68	19.90	19.61	19.90	150	50
Total Hardness	mg/lit	361.94	358.38	305.71	303.33	304.92	500	150
Iron (Ferro)	mg/lit	0	0	0	0	0	1	0.3
Aluminum	mg/lit	0	0	0	0	0	0.5	0.1
Total coliforms	-	910	30	0	0	0	0	0
Fecal coliforms	-	910	30	0	0	0	0	0
Arrival water to filter	m^3/hr	145						
Exit water to filter in the start	m^3/hr	145						
Exit water to filter in the end	m^3/hr	128						
Time of function filter	hr	43						
Consumed chloride for disinfection	kg/hr	2.5						

After applying some changes in grain formation, samples were taken at points A, B, C, D, E. Surface load was equal to 3.7 lit/min (12 $m^3/hr/m^2$ in available filters in the refinery).

Then, the intended physical, chemical and biological tests were carried out on five samples, while the arrival and exit water were controlled, and so was consumed chloride rate from the filter. Table 5 shows the results of laboratorial data.

Table 5: The results obtained from different physical, chemical and biological tests on 5 samples of water in step 5

Date of test : June.20.2010	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Fresh Water Standard	
							Max admit	Max desired
Total solids (TS)	mg/lit	1015	975	880	876	874	-	-
Total suspended solids (TSS)	mg/lit	115	91	8	6	6	-	-
Total solution solids (TDS)	mg/lit	900	884	786	791	777	2000	500
Turbidity	NTU	112.4	61.3	3.63	2.92	2.83	5	1
Electric Guidance (EC)	µsem/cm	1587	1578	1482	1478	1471	2000	1500
Hydrogen ion viscosity (PH)	-	8.02	8.04	7.95	7.98	7.99	6.5-9.2	7-8.5
Temperature	ºC	21.7	22.1	33.9	22.6	22.7	-	-
Total alkalify	mg/lit	188.90	181.48	156.97	158.62	161.50	-	-
Calcium	mg/lit	97.37	96.82	88.90	88.35	88.51	200	75
Magnesium	mg/lit	33.06	31.32	25.52	25.38	24.91	150	50
Total Hardness	mg/lit	381.21	372.59	328.66	326.70	325.13	500	150
Iron (Ferro)	mg/lit	0	0	0	0	0	1	0.3
Aluminum	mg/lit	0	0	0	0	0	0.5	0.1
Total coliforms	-	11000	910	120	0	0	0	0
Fecal coliforms	-	11000	910	120	0	0	0	0
Arrival water to filter	m^3/hr	220						
Exit water to filter in the start	m^3/hr	220						
Exit water to filter in the end	m^3/hr	199						
Time of function filter	hr	31						
Consumed chloride for disinfection	kg/hr	2						

Step 6: Change in Type and Height of the Bed Materials (Perlite and Anthracite) and Surface Load Decrease

In this bed grain forming step, the under pressure filter model was recorded as in step five. The surface load was the same as the one in previous step i.e., 2/3 surface load, which is equal to 2.5 lit/min (8 $m^3/hr/m^2$ in available filters in the refinery). After applying the changes in grain forming and surface load, samples were taken at points A, B, C, D and E. Then the intended physical, chemical and biological tests were carried out on five samples, while the arrival and exit water of water exit were controlled, and so was consumed chloride rate from the filter. Table 6 shows the laboratorial data.

4. Results and discussion

The obtained grains from the intended physical, chemical and biological tests in different steps of the research show that the turbidity of arrival water to the refinery is refined after passing through the under pressure sand filters in step 1 with 85 units and the turbidity of the water is 88 units higher than the maximal admitted standard . In step 2, a decrease of 106 units was recorded. The turbidity of the refined water was 21 units more than maximal admitted standard. In step 3, a decrease of 103.1 units was recorded. The turbidity of refined water was 9.3 units more than maximal admitted standard. In step 4, a decrease of 111.7 units was observed; the turbidity of the refined at this stage water is 0.7 more than the maximal admitted standard. In step 5, a decrease of 109.57 units was recorded; the turbidity of the refined water at this stage was at a desired distance from the acceptable standard of the fresh water. In step 6, a decrease of 110.99 units was recorded, which was desirable.

Total Dissolve Solids (TDS) of arrival water to the refinery decreased from 38, 68, 82, 104, 123 to 131units during steps one to six respectively, which are at desirable levels all the way through. The Total Suspended Solids (TSS) of arrival water to the refinery increased from 137, 137, 212, 238, 109 to111 units respectively during the six steps. Total solids (TS) of arrival water to the refinery decreased from175, 205, 294, 341, 141 to 201 units respectively during the six steps. The Electric Conductivity (EC) of arrival water to the refinery decreased from 43, 148, 102, 144, and 116 to 133 units respectively during steps one to six, which are about maximal acceptable standard of fresh water.

Table 6: The results obtained from different physical, chemical and biological tests on 5 samples of water in step 6

Date of test : June.20.2010	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Fresh Water Standard Max admit	Fresh Water Standard Max desired
Total solids (TS)	mg/lit	1015	975	783	778	775	-	-
Total suspended solids (TSS)	mg/lit	115	91	5	4	4	-	-
Total solution solids (TDS)	mg/lit	900	884	776	772	769	2000	500
Turbidity	NTU	112.4	61.3	1.67	1.49	1.41	5	1
Electric Guidance (EC)	µsem/cm	1587	1578	1465	1466	1454	2000	1500
Hydrogen ion viscosity (PH)	-	8.02	8.04	7.92	7.92	7.90	6.5-9.2	7-8.5
Temperature	ºC	21.7	22.1	22.5	22.7	22.7	-	-
Total alkalify	mg/lit	188.90	181.48	156.14	156.76	158	-	-
Calcium	mg/lit	97.37	96.82	85.61	84.90	84.43	200	75
Magnesium	mg/lit	33.06	31.32	24.68	24.16	24.44	150	50
Total Hardness	mg/lit	381.21	372.59	316.89	312.97	312.97	500	150
Iron (Ferro)	mg/lit	0	0	0	0	0	1	0.3
Aluminum	mg/lit	0	0	0	0	0	0.5	0.1
Total coliforms	-	11000	910	30	0	0	0	0
Fecal coliforms	-	11000	910	30	0	0	0	0
Arrival water to filter	m^3/hr	145						
Exit water to filter in the start	m^3/hr	145						
Exit water to filter in the end	m^3/hr	130						
Time of function filter	hr	48						
Consumed chloride for disinfection	kg/hr	1.5						

The total rate of Alkalify of arrival water to the refinery decreased from 23, 14.6, 10.8, 11.6, and 27.4 to 30.9 units respectively during steps one to six, all of the steps place on maximal admitted and desired standard of fresh water. The Calcium of arrival water to the refinery, after passing through under pressure sand filters decreased from 3.64, 9.05, 9.27, 7.05, 8.86 to 12.94 units respectively during steps one to six, which was a maximally desirable standard of fresh water throughout.

The total hardness rate of arrival water to the refinery, after passing through under pressure sand filters, decreased from 11.46, 38.1, 25.74, 57.02, and 56.08 to 68.24 units respectively during steps one to six, which was a maximally desirable standard of fresh water throughout.

The Magnesium rate of arrival water to the refinery, after passing through under pressure sand filters, decreased from, 0.57, 3.71, 4.65, 9.45, and 8.15 to 8.62 units respectively during steps one to six, all of the steps have been less than maximal admitted and desired standard of fresh water.

The decrease in the total Coliforms of arrival water to the refinery after passing through under pressure sand filters was 19700 units in the first step. That of refined water was 4300 units, which is more than the standard rate. In step 2, it was 3370 units. That of refined water was 930 units, which is more than the standard rate. In steps 3 and 4, it was 910 units, with a rate of zero in the refined water, which is desirable. In steps 5 and 6, it was 11000 units with a rate of zero, which is desirable, as well.

The decrease in the rate of Fecal Coliforms in arrival water to the refinery, before water is refined, was 3390 units in step 1 after passing through under-pressure sand filters. That of the refined water was 910 units, which is more than the standard rate. In step 3, it was 4090 units. That of refined water was zero, which is desirable. In steps 5 and 6, it was 11000 units, with a zero rate for refined water, which is desirable.

The rate of Iron Aluminum in samples of all steps was zero, which is standard for fresh water.

The analyses of the laboratorial data and the outputs of every step resulted in proposing equation one as the optimal output, with a turbidity decrease in steps five and six, as 99% and 98% respectively (Fig. 3).

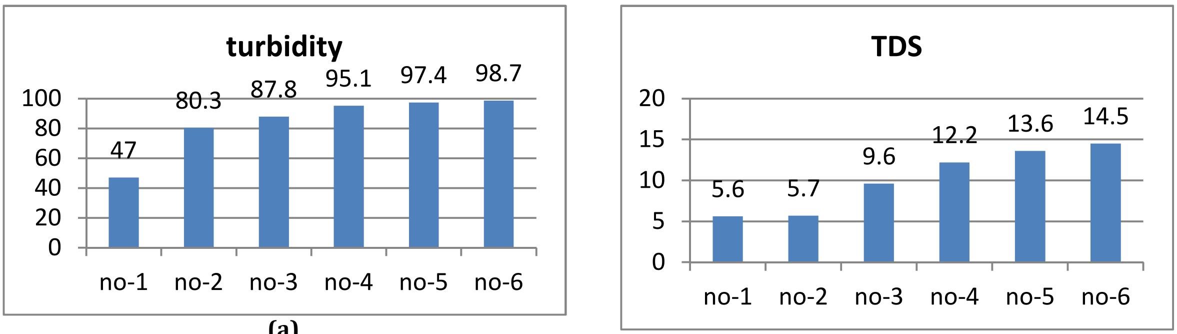
$$R = ((A-B)/A)*100 \quad (1)$$

R = Output

A = Rate of observed parameter in arrival water to the refinery

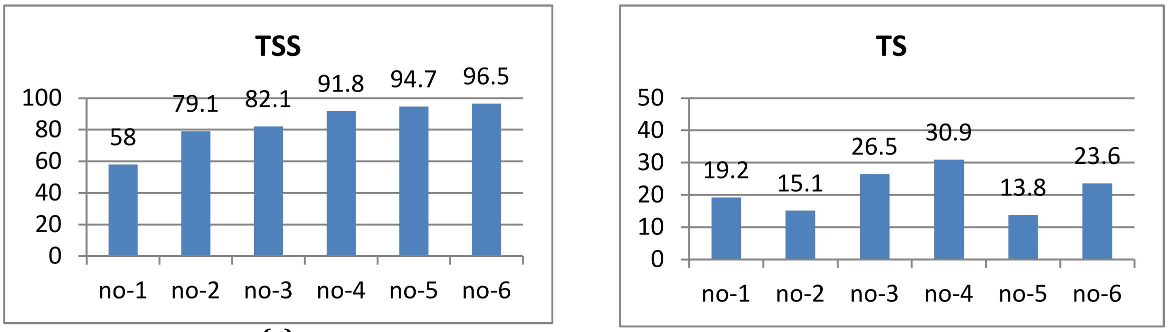
B = Rate of observed parameter in the refined water after flowing through under pressure sand filters

The best output of the TDS decrease is related to step 6 as 10% (Fig. 3). The best output of TSS decrease is related to step 6, as 97% (Fig. 4). The best output of TS decrease is related to step 4 and 6, as 31 and 24% respectively (Fig. 4). The best output of EC decrease is related to step s4 and 6, as 10 and 9% respectively (Fig. 5). The best output of Total Alkalify decrease is related to step 6, as 17% (Fig. 5). The best output of Calcium decrease is related to step 6, as 14% (Fig. 6). The best output of Magnesium decrease is related to steps 4 and 6, as 33 & 26% (Fig. 6). The best output of total hardness decrease is related to step 6, as 18% (Fig. 7). The best output of total coliform decrease is related to steps 3, 4, 5, 6, as 100% (Fig. 7). The best output of fecal coliform decrease is also related to steps 3,4,5,6, as 100% (Fig. 7). Rate of temperature, PH, Iron, Aluminum are all at national standard of fresh water with other mentioned parameters (Amrollahi, 2014).



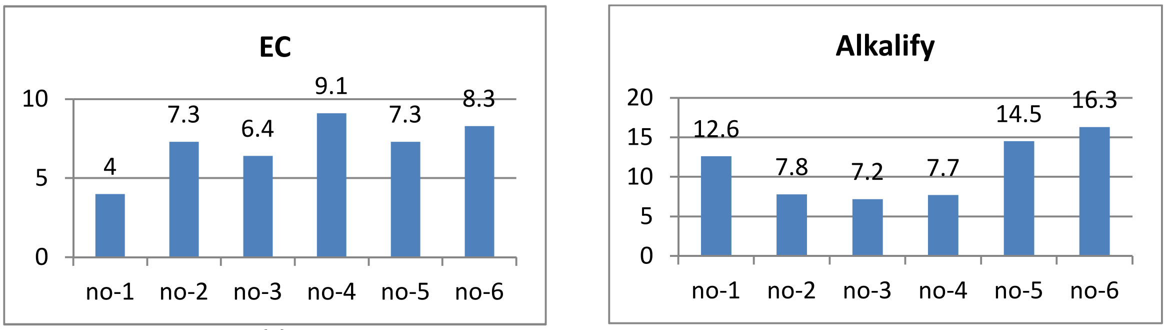
(a) **(b)**

Fig. 3: (a) Turbidity decrease output (percent); (b) TDS decrease output (percent)



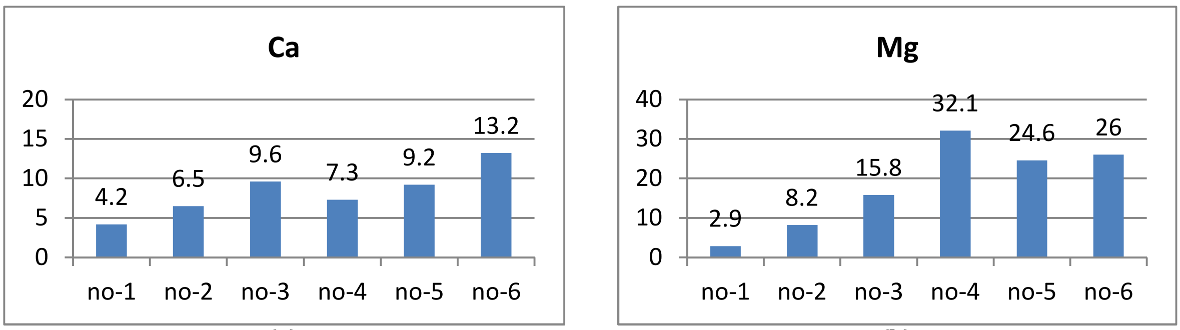
(a) **(b)**

Fig. 4: (a) TSS decrease output (percent); (b) TS decrease output (percent)



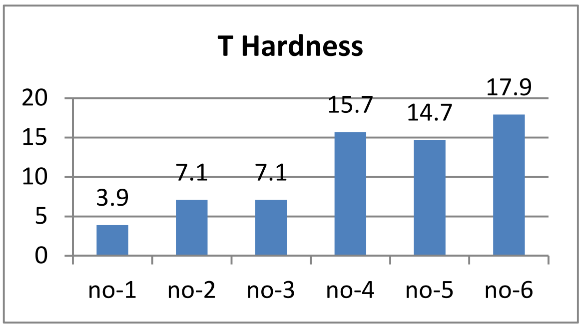
(a) **(b)**

Fig. 5: (a) EC decrease output (percent); (b) Alkalify decrease output (percent)

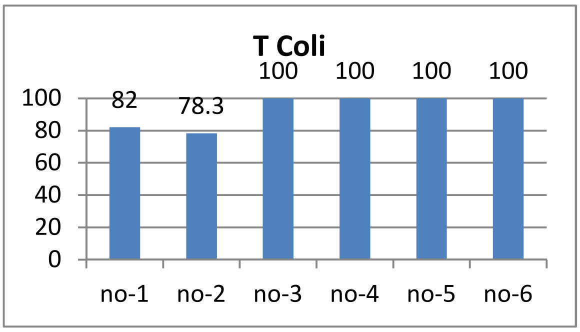


(a) **(b)**

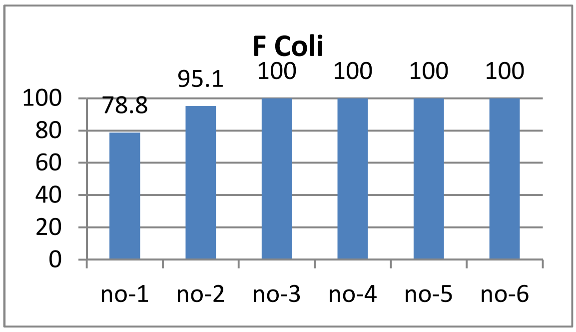
Fig. 6: (a) Calcium decrease output (percent); (b) Magnesium decrease output (percent)



(a)



(b)



(b)

Fig. 7: (a) Total Hardness decrease output (percent); (b) Total coliforms decrease output (percent); (c) Fecal coliforms decrease output (percent)

The most temporal quantity for the pressure decrease of 0.5 bar was observed in under pressure sand filters and inversed wash step, which was related to steps 6 and 4, as 48 and 43 hr. The least consumed chloride gas rate for disinfection was related to step 6, as 1.5 kg/hr, with respect to chloride remaining in the consumer's fresh water. finally , it is concluded that for supplying the desired fresh water according to national standards of fresh water in the Shahid Almassi rural fresh water refinery 6 sets under pressure sand filters should be applied, three of which should be simultaneously active, so that the filter's surface load may reach 66% of actual surface load. It is also suggested that perlite than silicium should be used in bed of these filters as they are very cheap. Both perlite and anthracite can be used simultaneously at the mentioned rate and height in the step 5. Meanwhile, the coagulative step may be also used in solid chloride poly-aluminum with doze of injection of 6 ppm for coagulation function.

5. Conclusions

With attention to this point that refinement process in drinking waters is more important and more complex than other waters such as underground waters due to salts and colloid substances, so we should take care to select sand purity fitters and to select its type, and by selecting the best graining in fitters and the best quality of materials and by spending lowest cost, physical, chemical, biological and the most important of all, reach the water darkness to standard and favorite point. Performed analysis of fitter materials in refinery of Shahid Almasi Shebian was done in six steps, which in the first step without coagulator and in the second step by the best coagulator and in the third to sixth step was done the changes and tests by changing the type high of materials, that the best type and amount of used coagulating material in refinement process, surface load of filters and also type and size and high of materials in filters bottom has significant influence in performance and efficiency of filters. In this manner, to provide favorite and high quality drinking water, according to international standards of drinking water in refinery of Shahid Almasi is suggested. Instead of 4 systems, 6 sand filter systems under pressure is used, that 3 systems of them are active simultaneously that in this way without decreasing the amount of productive clean water, we can reach surface lead of filters to 0/66 of current load, and in the bottom of these filters with regard to obtained results in this research and cheap cost of perlite that silica we can use perlite and Antrasite at the same time at the amount and high of mentioned in step 5. Moreover, in coagulation step for coagulation operation, Poly Aluminum chloride solid with 6 ppm injection.

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