

***Short summary of pilottest study in Babite WTP
(23.02.12. – 20.03.12.)***

Rīga, 22 March of 2012

Introduction

The objective of pilot study was to confirm efficiency of iron removal technology for groundwater treatment in Babite village and specify design parameters of water treatment equipment. Field study was conducted by company SIA „Ūdens inženiertehnoloģijas” engineers Janis Brutgans-Krasts and Janis Zelmenis.

Description of pilot unit

Main elements of Babites WTP pilot study unit were following:

- a) filter column with height $H= 2,2$ m and DN 150, filled with filter material;
- b) artesian pump with maximum capacity $3,3$ m³/h and maximum pressure 5 bar;
- c) air compressor with air capacity 2,83 l/sek and maximum pressure 10 bar;
- d) mechanical flowmeter with maximum flow capacity $1,5$ m³/h;
- e) process pipes and regulation valves;
- f) temporary electricity supply system.

Filter column was filled with following filter materials:

- | | |
|--|---------|
| 1) support gravel with particle size 2...20 mm | H=35 cm |
| 2) lower filtration layer Filtralite HC 0,8...1,6 mm | H=50 cm |
| 3) upper filtration layer Filtralite NC 1,5...2,5 mm | H=50 cm |

Artesian water for filtration and filter backwashing was pumped from newly constructed artesian well with depth 165 m and total water production capacity 12 l/sec.

Water sampling methodology

For analysis of pilot unit water treatment process efficiency, raw and filtrated water were analysed for two-valent and total iron content, pH and dissolved oxygen content. We were using following analytical equipment:

- a) For two-valent and total iron content – spectrophotometer HACH DR/2000;
- b) For dissolved oxygen and pH - WTW MultiLine P4.

After reaching positive water treatment results, 7 samples of raw and treated water were taken for analysis in certified laboratory. For these samples following water content parameters were analysed:

- 1) In raw water – total iron, manganese and sulphate concentration;
- 2) In treated water – total iron and manganese concentration.

Raw artesian water quality

According to artesian well water quality analysis in certified laboratory, artesian water used for pilot study has following main characteristics:

pH	7,39
Permanganate index	0,33 mg/l
Sulphate ions, SO ₄	238 mg/l
Total iron, Fe	1,38 mg/l
Manganese, Mn	0,03 mg/l

These results means that according to Latvian standarts (the same quality requirements as in EU directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption) in raw artesian water only maximum permitted iron content is exceeded and needs to be reduced. Other water parameters are within limits.

Water treatment process

Raw water was continuously pumped (all day around) from artesian well directly to filtration column with short interruptions for filter backwashing. The infow rate into filter column was adjusted manually with gate valve. Before filter into raw water was added controlled amount of compressed air, to facilitate treatment processes within filter. Backwash water was taken from artesian well. Both filtrated and backwash waters where disposed in near by storm water drainage system.

Total iron content in treated water according to our Termos of Refference shall not exceed 0,1 mg/l. Target filtration rate was 20 m/h and up. Summary of pilot study quantitative results is presented in table 1.1.

Table 1.1. – Water quality analysis results.

Nr.	Date, Sampling place	Average filtration rate m/h	Water analysis results using field equipment (HACH DR/2000 and WTW MultiLine P4)				Water analysis results from SIA „Vides Audits” certified laboratory			Notes
			Fe ²⁺ mg/l	Fe tot mg//	pH	O ₂ mg/l	Fe tot mg/l	Mn mg/l	SO ₄ mg/l	
1.	24.02.12	17,2	1,00	1,24	7,18	1,56	-	-	-	
	Raw water		0,88	1,21	7,20	2,85	-	-	-	
	After treatment									
2.	27.02.12	19,9	-	-	-	-	-	--	-	
	Raw water		0,71	0,97	7,20	2,44	-	-	-	
	After treatment									
3.	01.03.12	17,3	1,09	1,35	7,12	1,70	-	-	-	Backwashing of filter with water - flowrate 40 m/h
	Raw water		0,55	0,82	7,19	1,87	-	-	-	
	After treatment									
4.	05.03.12	16,7	0,77	1,37	7,28	1,77	-	-	-	Backwashing of filter with water - flowrate 45 m/h. Problem – minimum outwashing of Filtralite material!
	Raw water		0,06	0,07	7,16	1,81	-	-	-	
	After treatment									
5.	08.03.12	20,5	1,33	2,03	7,16	1,33	-	-	-	Backwashing of filter with water - flowrate 40 m/h
	Raw water		0,02	0,04	7,23	1,73	-	-	-	
	After treatment									
6.	09.03.12	17,1	0,99	1,32	7,26	1,62	-	-	-	
	Raw water		0,07	0,17	7,40	1,84	-	-	-	
	After treatment									
7.	12.03.12	22,4	-	-	-	-	1,43	0,035	211	Backwashing of filter with water - flowrate 40 m/h
	Raw water		0,04	0,09	7,20	1,38	< 0,05	0,019	-	
	After treatment									

8.	13.03.12									
	Raw water	22,2	-	-	-	-	1,38	0,025	212	
	After treatment		0,11	0,19	7,20	1,89	0,13	0,028	-	
9.	14.03.12									
	Raw water	23,1	-	-	-	-	1,32	0,024	210	
	After treatment		0,05	0,07	7,22	1,38	< 0,05	0,020	-	
10.	15.03.12									Backwashing of filter with water - flowrate 40 m/h
	Raw water	23,9	-	-	-	-	1,40	0,017	211	
	After treatment		0,03	0,07	7,44	1,60	< 0,05	0,020	-	
11.	16.03.12									
	Raw water	23,1	-	-	-	-	1,30	0,022	209	
	After treatment		-	-	-	-	0,088	0,017	-	
12.	19.03.12									Backwashing of filter with water - flowrate 40 m/h
	Raw water	25,1	-	-	-	-	1,31	0,023	211	
	After treatment		0,03	0,04	7,09	2,21	< 0,05	0,023	-	
13.	20.03.12									Backwashing of filter with water - flowrate 40 m/h
	Raw water	22,7	-	-	-	-	1,27	0,023	210	
	After treatment		0,02	0,07	7,22	1,33	< 0,05	0,023	-	
14.	21.03.12									
	Raw water	35,4	-	-	-	-	-	-	-	
	After treatment		0,00	0,03	7,11	1,88	-	-	-	

We were interested to continue pilot study with higher filtration rates to find the maximum limits where iron is still removed to target maximum concentration of 0,1 mg/l and what happens if we interrupt water feed to filter for certain period of time, but unfortunately pilot study had to be stopped due to ongoing construction works in Babite WTP construction site.

Conclusions:

- 1) Tested iron removal technology and filter material are very efficient for Babite WTP and water filtration rates can be 20 m/h and higher;
- 2) Tested iron removal technology starts fully efficiently operate only after 3-4 weeks due to gradual development of biochemical processes in filter material;
- 3) Treatment efficiency drops after backwashing;
- 4) Filtralite multilayer material HC 0,8...1,6 mm + NC 1,5...2,5 mm has a large volume capacity and pressure drops in filter are not rising even after running of water treatment process with high filtration rate >20 m/h continuously for 4 days;
- 5) Filter backwash rate shall not exceed 40 m/h, because with higher rates spillage of filter material has been noticed.