

Kibbutz Revadim effluent treatment pilot plant. A comparison between AFM and sand filtration

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General:

Starting from August 2001 Arkal Filtration systems have been running an effluent tertiary water treatment unit tests in Kibbutz Revadim in the south part of Israel. Water source is an effluent water coming from Jerusalem biological treatment plant. The water is collected for Kibbutz Revadim and stored in a reservoir for a period ranging from a few days up to many weeks, the water is then used for irrigation.

Because of the climatic conditions (long detention time and lots of sunshine) algae growth is enormous, BOD and NTU increases dramatically, and all of the irrigation equipment becomes clogged. The ministry of health limits the BOD, NTU and CFU levels for irrigation use, Arkal was therefore asked to deal with that problem.

Process description:

The pilot plant was designed as fully automated with a programmable controller. It is connected to an MMI system through a PC computer. Thus one can view and control at any time the process parameters such as turbidity, delta pressure and residual chlorine.

Flow rate- 10 m³/hr

Water is flowing in from the outlet of the reservoir and pre-oxidized with sodium hypochlorite the purpose is to cut long organic chains and to lower the organic load (which might be quit high). The dosing rate is pulse controlled by a flow meter.

The water is then filtered via Arkal patented Spin Klin Disc filtration. The disc are grooved polypropylene type, the degree of filtration is 100 micron. The unit is automatically back flushed by time or delta pressure. The water is then coagulated with Al₂(SO₄)₃. The purpose is to agglomerate small organic particles into flocs that can be later removed by the media filter. The dosing rate is pulse controlled by a flow meter. After that the water are static mixed.

The next stage is media filtration. Arkal has decided to go with two types of media in parallel and to compare between them.

Support basalt (20 cm) + quartz no one (45 cm)+ anthracite no 2S (45 cm)
Support basalt (20 cm) +AFM type one (90 cm).

Filtration vessels are made from CI epoxy coated inside and outside. Valves are pneumatically operated with limit switches.

Back flush velocity (with treated water) is 45-50 meters per hour
Air velocity is 65-70 meters per hour.

After filtration the water is disinfected with sodium hypo chlorite (0.5 ppm) and stored for half an hour in a reservoir (which is also used as a source of back-flush water)

Working parameters:

The following field parameters are monitored and viewed via a PC computer:

Inlet turbidity and outlet turbidity from each filter
Delta pressure on each filter
Residual chlorine
Water flow rate

The starting process parameters:

Oxidation- 6-8 ppm
Coagulation- 5-7ppm
Disinfaction- 1-2 ppm
Filtration velocity- 8 meter per hour
Back flush velocity- 50 meters per hour
Back flush time- 2 minutes
Air velocity- 65 meter per hour
Air time- 1 minute
Delta pressure for media regeneration-0.7 bar
Delta pressure for disc filter back flush- 0.6 bar

Results:

Attached are few of the representative results obtained during pilot tests

A. 8 ppm of chlorine, 6 ppm of coagulant, 8 meter per hour per filter, regeneration with air.

Filter A is with anthracite

Filter B is with AFM

Two runs

parameter	inlet	after filter A	after filter B
TURBIDITY (NTU)	120	12	3
BOD (MG/L)	90	17	9
TSS (MG/L)	85	10	5
VSS (MG/L)	79	9	2
CFU (100ML)	75000	55	0
TURBIDITY (NTU)	85	7	2
BOD (MG/L)	75	10	3
TSS (MG/L)	55	6	2
VSS (MG/L)	50	5	1
CFU (100ML)	67000	40	0

B. 6 ppm of chlorine, 4 ppm of coagulant, 10 meter per hour per filter, regeneration with air.

Filter A is with anthracite

Filter B is with AFM

Two runs

parameter	inlet	after filter A	after filter B
TURBIDITY (NTU)	65	5	0.8
BOD (MG/L)	35	8	2
TSS (MG/L)	40	5	5
VSS (MG/L)	38	5	2
CFU (100ML)	60000	10	0
TURBIDITY (NTU)	24	3	0.5
BOD (MG/L)	28	10	0
TSS (MG/L)	30	4	2
VSS (MG/L)	25	2	1
CFU (100ML)	16000	5	0

C . 6 ppm of chlorine, 2 ppm of coagulant, 12 meter per hour per filter, regeneration without air.

Filter A is with anthracite
Filter B is with AFM

Two runs

parameter	inlet	after filter A	after filter B
TURBIDITY (NTU)	35	5	2
BOD (MG/L)	40	20	12
TSS (MG/L)	45	25	6
VSS (MG/L)	42	22	5
CFU (100ML)	50000	30	0
TURBIDITY (NTU)	45	6	5
BOD (MG/L)	50	5	3
TSS (MG/L)	28	5	2
VSS (MG/L)	25	3	2
CFU (100ML)	35000	10	0

Conclusions:

The AFM media performs much better than quartz plus anthracite media in reducing BOD, VSS, CFU, NTU in high organic loaded water, especially with algae.

Time between regenerations was short (every 4-6 hours). In the AFM filter it was shorter in 1 hour.

Viruses and bacteria were removed extremely well in the AFM filter. It seems that coagulation is needed even for the AFM. Aeration during back flushing is questionable.