

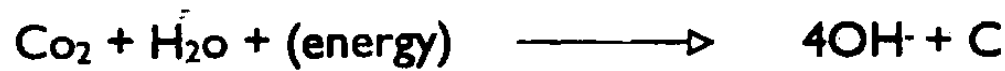
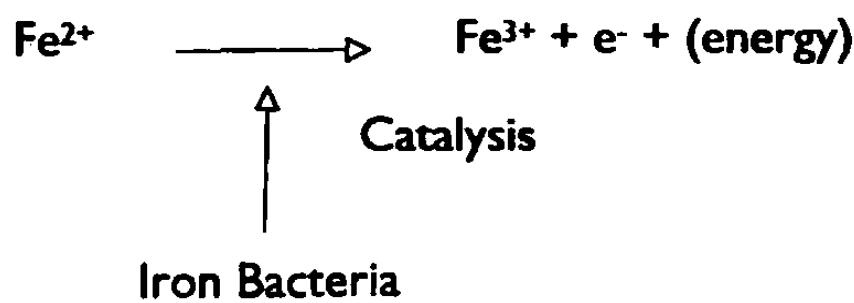
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INTRODUCTION

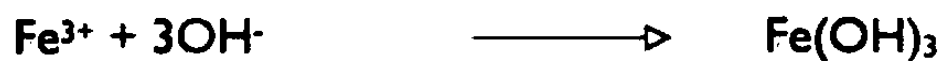
The water source of Joyo City, Japan, is a deep well and the raw water contains impurities such as iron and manganese in concentrations about 0.41 mg/l and 0.12 mg/l respectively as shown in Table 01. The existing water treatment plant has a capacity of about 11,000 m³/d and iron and manganese are removed using a biological treatment. It utilizes bacillus that already exists in raw water and accumulates it on the surface and the internal filter layer. The system oxidizes and removes iron and manganese as the bacillus works. Iron and manganese removal is using iron bacteria (Leptothrix, Gallionella etc.).

THEME 3

1.1 Processing mechanism of iron and manganese



The carbon in CO₂ is fixed and synthesized in the cell



Manganese is the same mechanism as the above

EXAMINATION SUBJECTS

The study focussed on examination of scheme design condition on the following subjects.

- Method of breeding
- Filtration rate
- Iron and manganese removal rate
- Necessity of dissolved oxygen addition
- Filter medium (Single layer or double layer)
- Washing method (amount of wash water and washing time)

METHODOLOGY

From the microscopic analysis, it was found that the dominant iron bacteria was Leptothrix sp which is naturally found in raw water (figure 01). This bacteria has the ability to oxidize both iron and manganese with the existence of moderate dissolved oxygen.

The method of treatment consists of aeration with receiving well and filtration. The amount of dissolved

oxygen is increased from 1 mg/l to 5-7 mg/l by aeration which lead the activation of iron bacteria. The filtration rates were gradually increased from 20 m/d to 90 m/d and samples were collected for testing at different age of the filter.

Iron bacteria are caught in the surface of the filter layer, breed, and form the iron bacteria layer. This iron bacteria layer is cohesive, and can cause the filtration blockage in a short time. Therefore, to retard the filtration blockage large pieces of anthracite on the small filter sand was used. The thickness of the filter medium and the effect of processing of iron bacteria was measured by the iron and the manganese concentration in a perpendicular direction. Table 02 shows the water quality change in filter layer in perpendicular direction.

RESULTS

The iron bacteria breed at the filtration rate of 30 m/d. Neither iron nor manganese was detected above the target level in the filtered water at the filtration rate of 70 m/day as shown in figure 02 and figure 03. The filtration continued without excluding iron bacteria and the breeding increased the biomass. As a result, the effect of iron removal is noticeable in about one week, and the manganese removal reached less than processing target value, which is 0.05mg/l; for both iron and manganese; in about one month. When the filtration rate reached 60-70m/d, the iron removal required 3-4 weeks and the manganese removal required 3-4 months of steady processing. The experiment was conducted within the range of 20-90m/day of filtration rate. The greater part of the data satisfies the treatment target value. In particular, manganese obtain steady treatment when becoming manganese sand by a biological action. It was also noticed from the results that the greater parts of iron and manganese have been removed by the anthracite layer.

The backwashing rate was judged based on the exhaust rate. Table 03 shows sixteen conditions of selected backwashing methods. The exhaust rate was almost 100% in seven different backwashing conditions (2,3,8,9,14,15,16) and in the rest of the conditions exhaust rate exceeded 100% showing that bacteria flow out by excessive washing.

CONCLUSION

The raw water of this treatment plant can be treated at the filtration rate of 90m/d. But a value of 70m/d is recommended for design purposes. Further, it is recommended to extend the study in future in the following areas.

- Verification of stability of processing (time, seasonal stability)
- Interception necessity of another microorganism

Table 01: Ground water quality

Parameter	Value
Fe (mg/l)	0.41
Mn (mg/l)	0.12
Color (Degree)	2
Turbidity (Degree)	0.9

Table 02: water quality change in filter layer perpendicular direction.

Perpendicular direction (cm)	Fe (mg/l)	Mn (mg/l)	Filter run (hr)
0	0.74	0.18	72
10	0.06	0.03	
30	0.05	0.02	
60	Less than 0.03	Less than 0.005	

Table 03: Summary of washing condition

Condition	Washing Time			Surface washing rate (m/min)	Back washing rate (m/min)	Amount of Washing (m ³ /times)
	Surface	Surface and Back	Back			
1	1	1	1	0.28	0.7	1.96
2	2	1	2	0.28	0.7	2.94
3	2	1	2	0.28	0.58	2.58
4	3	1	3	0.28	0.58	3.44
5	3	1	3	0.28	0.58	3.44
6	3	3	1	0.28	0.58	4
7	1	3	2	0.19	0.58	3.66
8	2	3	1	0.19	0.58	3.27
9	2	3	1	0.19	0.58	3.27
10	2	3	1	0.19	0.58	3.27
11	2	3	1	0.19	0.58	3.27
12	2	3	1	0.19	0.58	3.27
13	2	3	1	0.2	0.58	3.32
14	1	2	1	0.2	0.58	2.34
15	1	2	1	0.2	0.58	2.34
16	1	2	1	0.2	0.58	2.34

THEME 3



Figure 01: Leptothrix sp

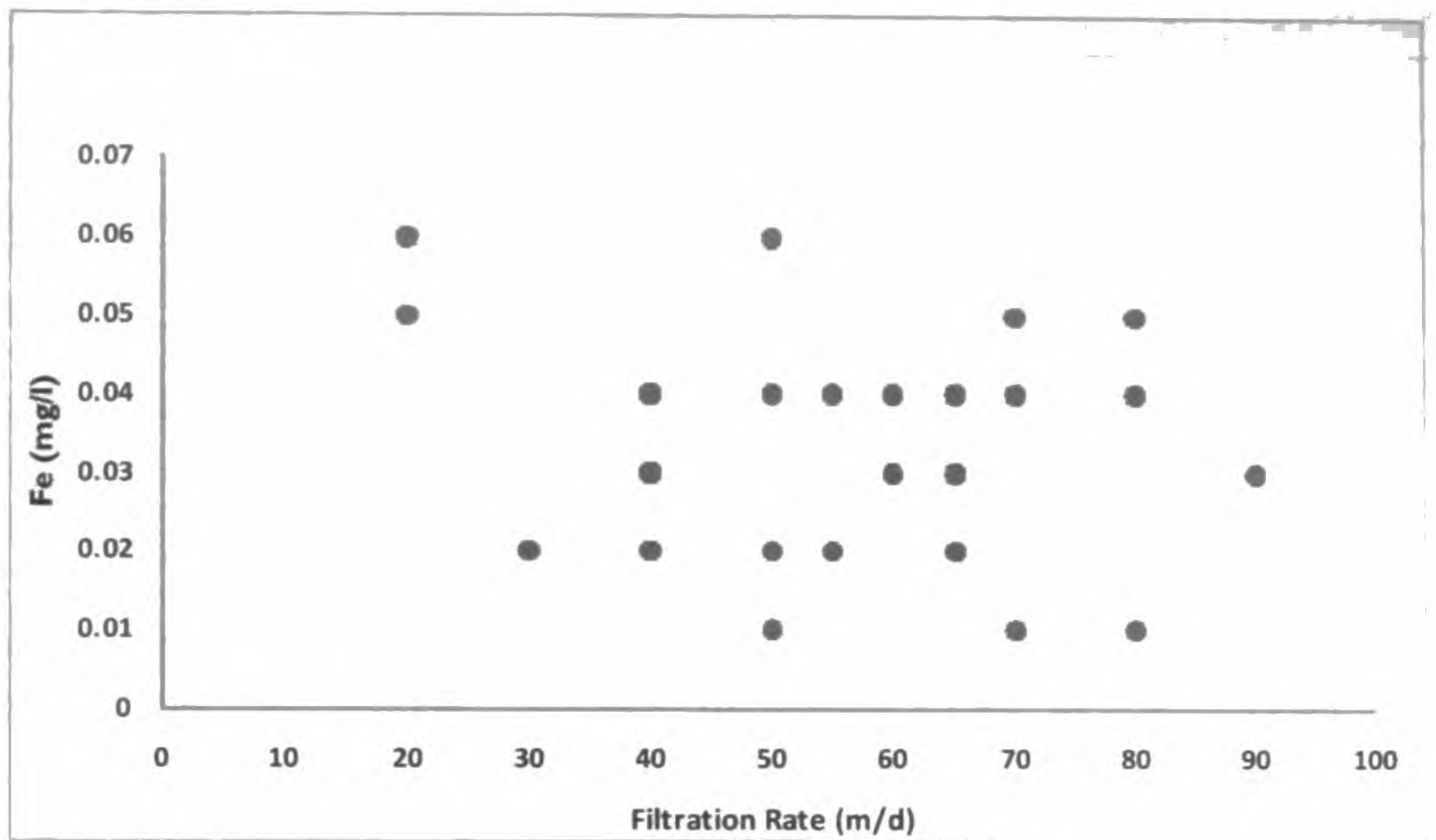


Figure 02: Filtration rate and iron removal rate

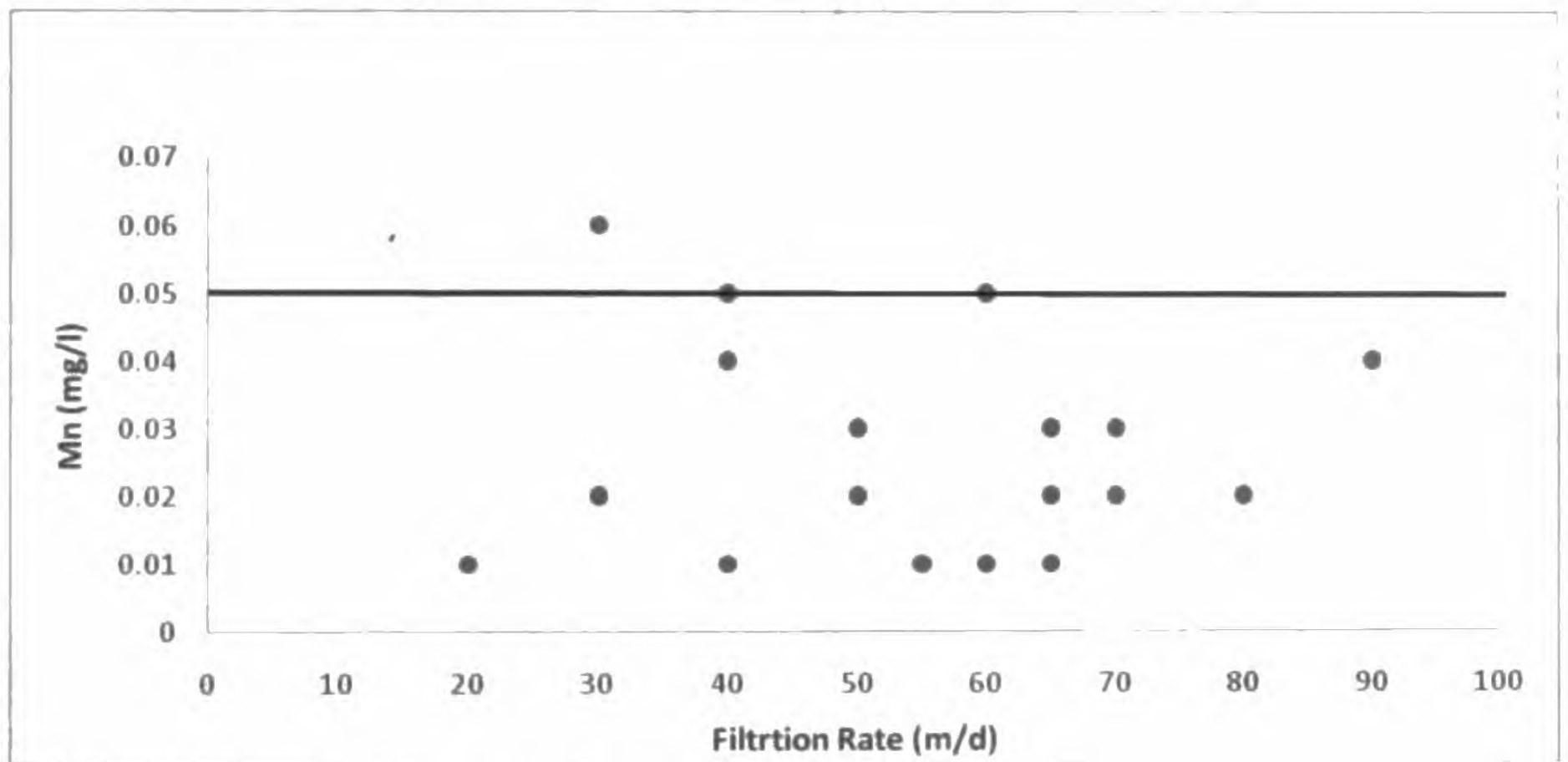


Figure 03: Filtration rate and iron removal rate