TITLE: A solution to Scaling Problems and Operational Difficulties in Mihintale Drinking Water Supply Scheme.

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2. Abstract

Mihintale drinking water supply scheme is responsible for providing 1000 m^3 of drinking water. The scheme consists of six bore holes. An aerator unit, a horizontal roughing filter system and a disinfection unit currently, three bore holes and the disinfection unit are in operation. Excessive alkalinity and water hardness restrict the usage of water from other Bore holes. Scale formation often block the water meters, reduce the water carrying capacity and leave the deposits on the boilers. Therefore reduction of p^H and alkalinity is essential to reduce the scale formation in water. In this case acidification process is introduced to the scheme and low concentrated Sulphuric acid is treating to the water before distributing to the community.

3. Main body of the Text

3.1 Background and Objectives:-

Mihintale drinking water supply scheme is responsible for providing 1000 m^3 of drinking water. The scheme consists of six bore holes, an aerator unit, a horizontal roughing filter system and a disinfection unit. Currently, three bore holes and the disinfection unit are in operation. Excessive alkalinity and water hardness restrict the usage of water from the other bore holes. Scale formation often block the water meters, reduce the water carrying capacity and leave the deposits on the boilers. The emphasis of this study is to reduce the scale formation, alkalinity and p^H hence to improve the quality of drinking water and minimize the operational difficulties.

3.2 Research Design / Materials and Methods

In order to determine the water quality parameters, water samples were collected from each bore hole in to acid pre-treated plastic containers. Colour, p^H , Turbidity and electrical conductivity were monitored on the location. The other parameters were monitored from the refrigerated samples within a day or two. All the measurements were done

by using the standard methods prescribed by Sri Lanka Standards. Alkalinity of water was measured by filtrating a portion of the water samples with standard Supphuric acid solution, using methyl Orange as the indicator. Total hardness of water was determined by an EDJA titration using eriochrom black T as the indicator at p^H 10. Colourimetric method was used to determine the total iron content in water. In this method, Ferric irons were first reduced to ferrous state by using hydroxylamine in the acidic medium. Then that solution was treated 1-10 Phenanthroline to form an Orange red complex and its absorbence was measured at 510 nm wave length.

Turbidity meter was used to determine the turbidity of the solution. A DR 2000 spectophotometer was used to determine the colour of water sample. A conductivity meter and p^H meter (Orion SA 520) were used to measure the conductivity and the p^H of water. Chloride were determined gavimetrically using silver nitrate. Prior to the precipitation, solution was treated with dilute Nitric acid to prevent the precipitation of other silver salts. Fluoride iron selective electrode was employed to determine the fluoride level in water.

3.3 Results and findings

Chemical parameters such as p^H, fluoride content, alkalinity,water hardness,total iron content, total dissolved solid content and chloride content were monitored along with the physical parameters such as colour,turbidity and conductivity of the water from the six bore holes through out the year 1996. The range of the values (maximum and minimum) are referred in Table 01. Furthermore, it was found that the main constituents of the scale are calcium and magnesium carbonate crystals. Therefore, we believe that the alkalinity and the scale formation can be reduced by an acid treatment. Chemical parameters were tested for a pooled water samples after the addition of different amount of sulphuric acid and the results are summarized in the Table 02.

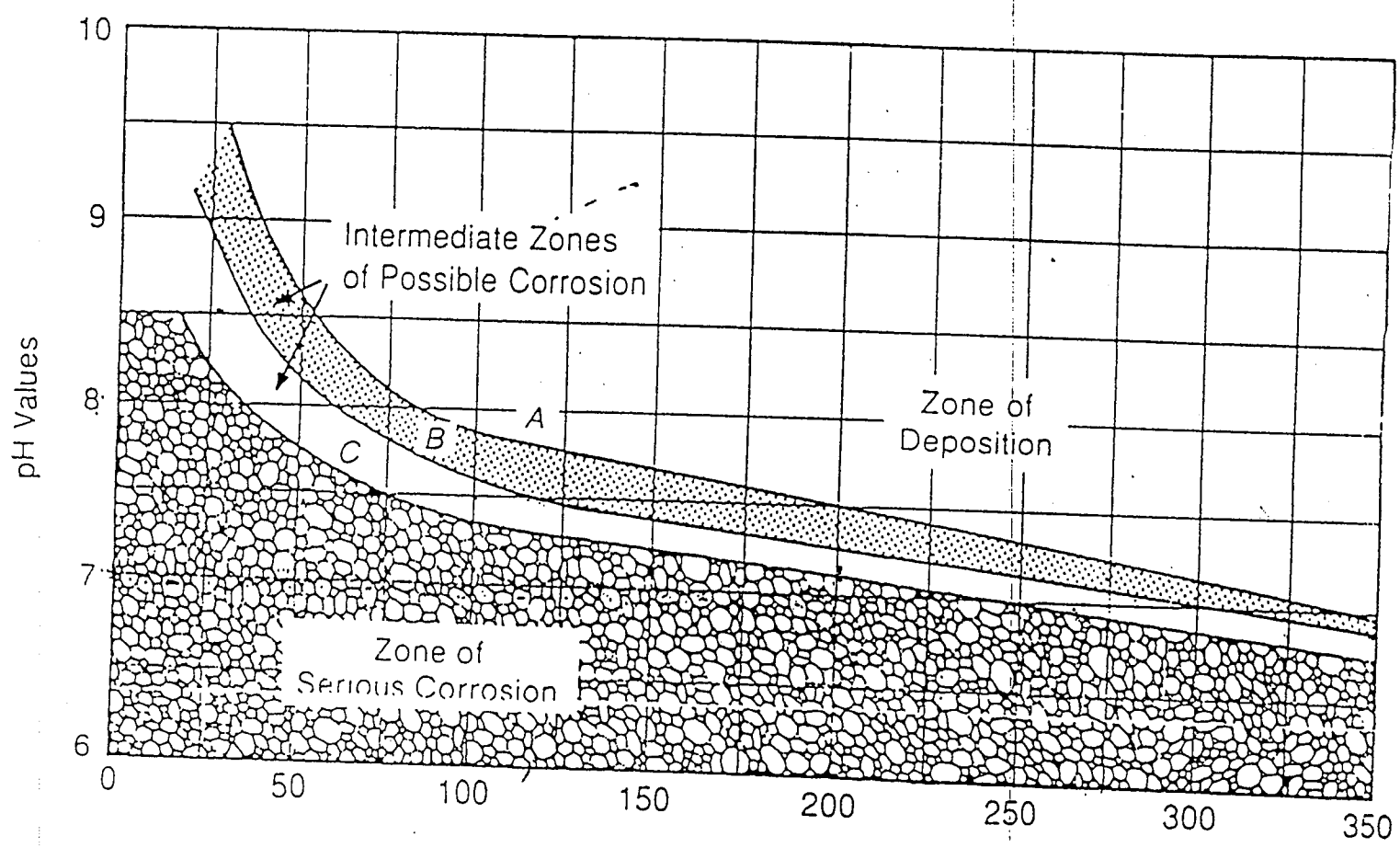
According to Sri Lanka Standards,permissible level of alkalinity and the p^H range of the drinking water are 350 mg dm^3 and 6.5 - 9.0 respectively. These conditions can be achieved by adding 10 cm^3 of 0.3 N sulphuric acid to 1000 m^3 of Mihintale water. Furthermore, under these conditions the possible metal corrosions associated with the drinking water systems are minimum, Figure 1. The alkalinity and p^H values before and after the acid treatment are given in Table - 3.

3.4 Conclusion and Recommendations:-

Addition of 10 cm^3 of 0.3 N sulfuric acid to 1000 m^3 of Mihintale drinking water has lowered the alkalinity and scaling problems significantly. Thus treated water satisfies the criteria specified by the Sri Lankan Standards and also minimizes the possible metal corrosion problems in water supply systems.

4. References:

* Text Book of quantitative in organic Analysis Vogel's
* Standard methods for the examination of water and waste water
* Specification for potable water physical and chemical requirements



NOTE:

A = Curve of values necessary to produce a coating of calcium carbonate.
B = Curve of calcium carbonate equilibrium.
C = Curve of values necessary to prevent iron stains.

Figure 7 The Baylis curve shows the relationship between the pH values and

Chemical & Physical parameters in Mihintale Bore Holes

LE - 01

	Capacity	pH		Fluoride (mg/l)		Alkalinity (mg/l)		Hardness (mg/l)		Total Iron (mg/l)		TDS(mg)		Chloride (mg/l)		Colour (pt.Co)		Turbidity (FTU)		Conductivity (Ms/cm)	
				min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
(1)	425	6.95	7.87	0.96	2.29	390	500	200	600	0.03	0.16	516	710	114	140	NIL	18	NIL	1	955	1420
(2)	425	6.85	7.93	1.08	2.09	420	480	260	600	0.07	0.15	537	544	70	93	NIL	14	NIL	2	985	1090
(3)	250	6.45	7.94	0.37	0.95	160	408	400	540	NIL	0.16	588	718	156	182	NIL	51	NIL	9	1110	1440
(4)	200	6.60	7.41	0.90	1.84	330	552	612	870	0.26	2.18	765	1410	276	311	5	48	4	40	1530	2820
(5)	300	6.75	7.4	0.67	1.75	220	360	700	840	0.07	0.95	910	1005	442	494	5	48	NIL	22	1810	2110
(6)	300	6.4	7.5	0.37	0.83	368	400	440	600	0.03	0.15	377	400	120	150	NIL	-	NIL	-	720	-
d r in)	-	7.15	8.38	0.45	2.06	380	520	240	600	NIL	0.05	521	595	218	240	NIL	20	NIL	1.0	1078	1190

TABLE - 02

Volume of the water sample (cm3)	Added H2SO4 (N)	Volume of H2SO4 (cm3)	After treatment of Acid	
			Alkalinity mg/l	pH
1000	-	0	470	7.69
1000	0.1	10ml	430	7.18
1000	0.2	10ml	370	6.88
1000	0.3	10ml	330	6.67
1000	0.4	10ml	250	6.41
1000	0.5	10ml	200	6.26
1000	1	10ml	NIL	3.13

TABLE - 03

Parameter	Before Acid Treatment	After Acid Treatment
pH	7.69	6.67
Alkalinity	470	330