

## Effectiveness of Domestic Defluoridator in Preventing Fluorosis in Kekirawa, Sri Lanka

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**SUMMARY:** Low cost domestic defluoridators based on freshly burnt brick chips as a sorption medium were distributed to 25 households having fluoride rich water in their wells in 1994-1995. The beneficiaries were belonging to middle class income group consisting of farmers, teachers and office workers. The fluoride removal and the occurrence of the fluorosis were monitored for about five years, up to 1999-2000.

During this period the fluoride levels in wells was 2.14 mg F /L. The treated water contained 1.20 mg F/L. The defluoridators thus were operated with an average removal efficiency of 57 %.

In 1994 17 children in the households were having mottled teeth. In 1999-2000 15 children in the households got permanent teeth. None of these children had dental fluorosis. It is discussed that this is an indicator of effectiveness of the program in preventing dental fluorosis.

**Key words:** Domestic defluoridator, brick chips, Sri Lanka, sorption, clay, preventing fluorosis, permanent teeth.

### INTRODUCTION

A survey of April 1994, carried out in Kekirawa, North Central Province, Sri Lanka, revealed that the village Olukradagama had fluoride rich wells, cf. Figure 1. The highest fluoride content of 3.5 mg/L was found in the well at Olukaradagama Vidyalaya. In the two hand-pump wells in the village the fluoride contents were 2.4 and 1.2 mg/L. In addition nearly 60 percent of the children of the age group of 10-18 years attending this school had ugly stained teeth. There was a well with a fluoride content of 5.1 mg/L in the village Thibbatuwewa, at the border of Olukarada village. Taking into consideration the above facts 25 low cost domestic defluoridators, described in details in a previous publications 1-3, were introduced in to this village in 1994 - 1995. The beneficiaries were farmers, teachers, clerks, drivers, soldiers etc. with different educational backgrounds. In this village most of the mothers of 20-30 years age group had dental fluorosis.

### METHODOLOGY

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**Selection of beneficiaries.** The domestic defluoridators were prepared locally and given to households with wells having fluoride content of more than 1.0 mg/L. In addition households having children of 0-3 years age were given priority. The filter medium utilised was freshly burnt broken pieces of bricks of sizes 10-15 mm. The bricks were available in the village more freely due to construction of the houses. Several awareness programmes were carried out to educate villagers to operate and maintain the filters.

**Sample collection.** The households were requested to collect two sets of water samples, untreated water and water from the outlet of the filter, in plastic bottles. The sample bottles were provided to the households on weekly basis. A record book was maintained in each household indicating the dates of collection of water samples. Staff from the National Water Supply and Drainage Board staff visited the households once a month in the first year of operation of the filters. Subsequently in the second and third years of operation the households were visited once every three months. Finally they were visited once every half-year in the fourth and fifth years.

**Fluoride analysis.** The samples were collected in acid washed plastic bottles. A programmable spectrophotometer, DR/2000, was used in determination of the fluoride concentrations using the SPANDS reagent. Occasionally some of the results were cross-checked with fluoride ion specific electrode available at the Biochemistry Department of the Faculty of Medicine, University of Peradeniya.

## RESULTS

Table 1 shows a list of the monitored households in Kekirawa who used the filter units for more than five years. The table indicates the filters' operational performances. Table 2 shows the occurrence of dental fluorosis in families in 1994 and 2000.

## DISCUSSION

From Table 1 it can be seen that most of the households changed the filter medium in time while some took their own time to do so. On an average the brick chips filters removed 1.22 mg /L of the household drinking water. This is corresponding to about 57 % removal of the raw water fluoride.

At the beginning 1994 - 1998 the operations of the filters were carried out systematically but in later years 1999 - 2000 the operations were unsatisfactory. There are various reasons given by them such as difficulty in obtaining bricks, damaged to the outlet pipe of the filter, other sicknesses in the household, due to curtailing of our visits etc. The maintenance problem of the filters was related to the damage to the outlet pipe. On their own they never made an attempt to repair it although it was a very easy job. They always wait for our arrivals to get it repaired. The fluoride content of the filtered water of these units was good and kept below 1.0 mg/L as shown in Table 1. On several occasions the fluoride content has gone above 1.0 mg/L due to delayed action of the changing the filter medium by the beneficiaries.

**TABLE 1.** Average fluoride concentrations of the raw water and the defluoridator water

No	Average fluoride content of the well (mg/L)							Treated water, mg F /L						
	1994	1995	1996	1997	1998	1999	2000	1994	1995	1996	1997	1998	1999	2000
1	2.28	2.95	2.91	2.24	2.21	2.45	2.61	1.08	0.93	1.42	1.60	1.30	1.41	1.50
5	2.40	1.76	2.95	2.42	2.16	-	-	1.00	0.85	1.49	1.21	1.10	-	-
10	1.54	1.63	1.70	1.55	1.30	1.45	-	0.69	0.63	0.73	0.44	0.62	0.52	-
11	2.10	1.72	1.91	1.92	1.65	1.85	2.05	0.95	1.00	1.20	1.50	1.00	0.80	1.30
12	1.95	1.75	1.70	1.86	1.90	1.80	-	1.00	0.85	0.50	0.60	0.80	0.75	-
13	2.25	1.48	1.50	1.25	1.45	1.50	-	0.85	0.70	0.75	0.81	0.75	0.60	-
14	1.64	1.42	2.18	1.72	1.68	1.82	-	0.75	0.82	0.90	0.95	0.50	0.85	-
15	1.44	1.15	1.72	2.06	2.18	1.98	-	0.78	0.43	1.20	0.97	1.16	1.20	-
20	2.42	2.06	1.52	1.60	1.52	1.80	-	1.20	1.08	0.84	0.97	0.87	0.78	-
21	1.96	1.93	1.92	1.95	1.50	1.85	-	0.86	0.72	0.64	0.87	0.95	0.90	-
26	2.22	1.74	2.05	1.86	1.25	1.62	-	1.18	0.63	1.27	1.40	1.00	1.10	-
42	4.78	4.25	4.20	2.84	3.35	3.80	4.10	0.85	0.99	1.35	1.00	1.20	1.15	1.20
44	2.90	0.75	2.25	1.23	1.80	2.60	2.70	0.45	0.40	0.70	0.35	0.62	1.00	0.85
60	-	2.43	2.90	2.22	2.37	2.48	-	-	0.72	0.85	0.47	0.85	1.00	-
74	-	1.65	2.24	2.42	1.80	1.85	1.95	-	0.75	1.20	0.50	0.70	0.65	0.80

In 1994, when the filter units were issued, most of the families had children of age group 0-3 years. By the year 2000 their permanent teeth were erupted and did not show ugly stained brown colour. They were milky white. Those who used the filter units with lot of understandings showed good results. It can be concluded that dental fluorosis has decreased in the year 2000 in comparison with the year 1994. In the house hold no. 26 the mother and the elder child had ugly stained teeth. The mother was born and bred in Olukaradagama. At the time of introduction of the filter unit to this household the purpose of the introduction of the filter was explained in detail as to other households in the village. In some of our visits it was observed that changing of the filter medium was not carried out on required time intervals. In short she was not that keen to use the filter on her own. By the end of the year 1999 her second child too ended up with dental fluorosis. The youngest child is three years old in year 2000 but filter was withdrawn due to her lethargic attitude.

**TABLE 2.** Comparison of dental fluorosis in study households in 1994 and 2000.

No.	Household Occupation	Ages in 1994	Children		Well water mg F /L
			With mottled teeth in 1994	With mottled teeth in 2000	
1	Co-op inspector	19,16,13	03	03	2.40
5	Farmer	16,14,13	03	03	2.40
10	Transport officer	9,7,1	01	01	1.54
11	Army	6,4,0	-	Nil	2.10
12	Farmer	7,3,1	-	Nil	1.95
13	Mason	1	-	Nil	2.25
14	Teacher	20,17,5	02	03	1.24
15	Farmer	16,11	02	02	1.44
20	Clerk	10,9,4,1	02	02	2.42
21	Farmer	21,18,12,2	03	03	1.96
26	Farmer	7,4	01	02	2.22
42	Baker	1	-	Nil	4.78
44	Farmer	7,4,1	-	Nil	3.15
60	Teacher	5,2	-	Nil	1.76
74	Driver	5,3	-	Nil	2.45

In the household no 14 the filter was issued when the youngest child was nearly five years. At the time of issuing the filter, it was explained that good results couldn't be obtained because the child is already five years old. The parents of the child happened to be the teachers in a near by school. Although they used the filter to near perfection, child had ugly stain in the permanent teeth. This case indicates that the child should be below three years at the time of issuing the unit.

In the household no. 44 the fluoride content of the well was 3.5 mg/L. They were advised to change the source and gave a bigger capacity filter unit. Here the fluoride content of the source has varied each year because of changing of the water sources. The operation of the filter unit was good in these five years in spite of the low-income level of this household. The housewife was assisting the farmer husband in their daily working environment. The child got good teeth in spite of the low level of socio-economic conditions in the family. This case indicates that if parents are willing to make an effort, they will be rewarded accordingly.

In the household no. 11, the mother had dental fluorosis. Her husband was in the war front fighting as a soldier. At times she found difficulty in changing bricks in time due to her pregnancy and the absence of her husband. The fluoride content of the well was 2.10 mg/L. However all her children" teeth were good at the end of five year operation of the filter.

The households nos. 1, 5 and 15 had elderly children with ugly stained teeth. The filter units were issued to these beneficiaries to check the efficiencies of the filter

units. The fluoride contents of the wells were in the range 2.0-2.5 mg/L. The fluoride contents of the defluoridated waters were in the range 1.0-1.6 mg/L.

In the household nos. 10 and 12 the elder children had dental fluorosis at the time of issuing the filter units. The young children of these households got milky white teeth at the end of five years. They have operated and maintained the filter units well as shown in table 1 where fluoride content of defluoridated water was maintained around 1.0 mg/L.

Household no. 20, the filter operation was carried out to near perfection as shown in the record sheet. She is a housewife and was able to get her young children with good-looking teeth. The two elder children had ugly stained teeth at the time of issuing the filter.

Household no. 60, the mother is a teacher in a nearby school. Because of her education level she understood the importance of the filter and carried out the operations well. In addition her farmer husband supported her by supplying and changing bricks in time. She too got good results.

In the household no.74, the father is a driver and the mother carried out farming in her leisure hours. The filter O & M was good in spite of their low income and educational levels, and the results were good.

In the year 2000, ten house hold units where children got permanent teeth does not have dental fluorosis in this village thus showing the effectiveness of the defluoridation programme in this village.

## **CONCLUSIONS**

- The filter unit could be used for more than five years if handled carefully because maintenance requirements are almost non-existence.
- The beneficiaries could repair breakage in the outlet pipe, if proper training is provided.
- The 4th and 5th year of operation of the filter unit continuously is an important issue to be highlighted to the beneficiaries.
- It is important to change the filter medium at the correct time for the defluoridation of water to be more effective.
- For fluoride content of 3.0 mg/L: with a withdrawing capacity mentioned at 15 liters/day, the defluoridated water could be kept below a fluoride content of 1.0 mg/L in this filter unit.
- There is low incidence of dental fluorosis in the new generation who reached 7-8 years in 2000 in this village.

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