Fluoride-Free Drinking Water Supply in North Gujarat The Rise of Reverse Osmosis Plants as A Cottage Industry

An Exploratory Study

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Executive Summary

Fluoride-Free Drinking Water Supply in North Gujarat:
The Rise of Reverse Osmosis Plants as a Cottage Industry

Drinking water is a 'delicate' issue and the need for the 'purity' of drinking water is well known. Drinking water comes mainly from the rivers or from the existent groundwater.

Excessive extraction of groundwater led to groundwater depletion caused brackishness due to salinity ingress. Hundreds of large plants in Gujarat, which were set up for supplying good and safe water to the public have been closed down in their wake. A large number of 'cottage' type Reverse Osmosis (RO) plants came to be marketed for supplying good and safe water to the consumers under 'packed drinking water' category, and a big market emerged.

For the purpose of this study, we use 'fluoride-free water' to mean treated water containing prescribed quantity of fluoride and not completely 'fluoride-free'.

The objective is to study these plants, its clientele and to estimate the future of this 'sun rise' industry. Under **the methodology** used, a detailed interview was conducted. Information were collected through a structured questionnaire administered to a select list of 14 RO plant owners, owning plants of different sizes and capacities, spread over 8 towns in undivided Mahesana district to make a broad estimate of RO plants in this area. A consumer survey was also conducted among consumers served by RO plants through a structured questionnaire for getting the consumer scenario. There were 60 such customers in the sample.

The RO or Membrane Technology for purification of brackish water came into use during 1960s. However its use in big and small (cottage type) industry and domestic kitchen followed during 1970s, 1980s and 1990s respectively. This technology reduces brackishness from the raw water up to 90 to 98 per cent. The costs of RO plants have been reduced to nearly 50 per cent in the world market between 1979 and 1991.

In osmosis, the solvent (water) flows to solution (salt-water) through semipermeable membrane, whereas in reverse osmosis, the flow of water is from solution (salt-water) to solvent (water) by applying pressure on solution (salt-water) side. This principal of reverse osmosis has been used in the technology for removing brackishness from the water having large amount of dissolved solids. Inlet water is delivered under pressure through the membrane, where water permeates the minute pores of the membrane in a spiral wound model and is delivered as purified water. The pressure that has to be generated for RO plant is dependent on the capacity of the plant.

The Government failed in supplying large-scale safe and good water to the public from its Large RO and De-Fluoridation Plants. Some cases have been cited in this report in brief, like that in Ismailpur in Patan, Methan in Sidhpur, where public system of de-fluoridation plants were being used, and in other places where RO plants were set up. Thus, in the private sector, a market for production of de-fluoridated water with less TDS by 'cottage' RO plants came into existence.

The Growth of 'Cottage' RO Plants in Gujarat

The RO plants of small capacity for 'cottage' industries came in the 1980s. Bislari brought the first bottle packed mineral water in between 1980 and 1984. Then Kothari Products Ltd started marketing packed drinking water under the name of 'Yes' in 1990. The small size plant of RO unit started coming to the market from 1995. The growth of RO plants in cottage sector in Gujarat reached its peak between 1997 and 2001. The largest number of small plant owners came to the market in 2000–01 (50per cent of 300 plants). During this time liquid package system, started in milk sector, helped the water sector too. Those occupied in producing mineral water found their market only in Jerry can of 10 and 20 litres. Later, with the introduction of packing machine for water pouches, people started producing pouches of 250ml. Pouches have their own market segments. Maybe, the idea generated from coloured sweet water available in plastic pouches which children called 'pepsi' in the village market. Combined together packaging machines, they ensured the growth of cottage size mineral water manufacturers especially in the area where healthy drinking water was not available. It is to be noted that there is a seasonal variation in the product of this industry particularly for the pouch-packed water. Pouches are sold at its 'peak' during March, April, May and June. Plastics used for making 'pouches' are degradable – the producers claimed. During the 'lean' season it has been reported to be 40 per cent less than that in the 'peak' period.

This industry got a jolt after the publication of a circular from Bureau of Indian Standards dated 29 March 2001, which made ISI certification mark compulsory. It proposed an in-house laboratory, which would cost Rs 3 to 4 lac approximately, plus to obtain the certification the owners have to pay an annual fee of Rs 84,000 every year. The smaller plant manufacturers of water packed in pouches have started closing down, particularly units producing pouch-packed water. Now, the number of active plant producing packed water including pouch-packed water is less than hundred.

Making ISI Mark Compulsory, means the small plant owners have spend an extra amount of Rs 4 to 5 Lacs plus the annual fee. This may force plant owners to increase the product price. The people are not sure whether quality would be assured by making ISI mark compulsory.

Plant Scenario

Out of these 14 plants from which we collected the data, 4 are in Mahesana, 3 each in Unjha and Patan, 1 each in Kadi, Visnagar, Sidhpur, and Chanasma. The plants of Visnagar, Sidhpur, Maktupur (Unjha) and Chanasma are situated in rural areas and cater mostly to the needs of their rural clientele. The plants of Kuktupur, Visnagar and Khali (Sidhpur) are situated in rural area and sells water in pouches within a radius of 100 kms. This plant of Khali has secured ISI certification. Some plant owners get their 'job-work' done in this plant. All these plants use their own brand name for their pouch-product.

Total client base of these 14 plants is 4890. Out of these 4890 families 3105 buy 10 litres of water per day and 1785 families buy 20 litres per day (LPD). The cost of 10 LPD is Rs 1500 a year, and 20 LPD the cost is Rs 2500 a year. Therefore, the average price of one litre water packed in Jerry-can/PET jar is (1500 ÷ 3650 =) Rs 0.41 or 41 Paise per litre when a client buys 10 LPD for the whole year, and it is 34 Paise per litre when a client buys 20 LPD for the whole

year. The pouch-packed water in of 250 ml is sold at ex-factory price of 30 paise per pack and consumers get it at MRP Re 1.00.

The plant capacity are varying from 500 to 2000 Litre Per Hour (LPH). There are 5 plants (35 per cent) have capacity between 500 and 900 LPH, 5 plants (35 per cent) have capacity of 1000 LPH and 4 plants (nearly 29 per cent) have capacity between 1000 LPH and 2000 LPH among the 14 plants.

The Economy of the Plants

The cost of plant installation is Rs 4 to 6 Lac approximately for 1000 LPH output-capacity, which includes RO plant machinery, packaging machine and stainless steel storage tanks. The average investment on plant machinery and pouch packing machine is found to be Rs 5.89 Lac per plant, taking 14 plants together. This would be nearly Rs 8 to 10 Lac if ISI certification were made mandatory.

The average annual production of water is 25.27 Lac Litre per plant; average sale turnover is Rs 15.39 Lac inclusive of pouch sales and average expenditure inclusive of interest on capital and depreciation comes to Rs 4.92 Lac per plant. Thus average profit is Rs 10.47 Lac per plant, which is nearly double the average investment of Rs 5.89 Lac for a plant.

The average cost of production per litre of water is found to be 0.19 paise taken 14 plants together. The 3 plants which are in loss having very high cost of production per litre of water, 0.48 paise, 0.37 paise and 0.68 paise. There are three plants have the lowest cost of production of 0.13 paise, among the three, the highest gross profit (Rs. 53.15 lac) is found in the plant at Khali in Sidhpur Taluka; other two must have some differences in their scale of production. This plant at Khali sales more pouches than 10 or 20 litre packs of water.

The average profit per plant is Rs 10.47, which is nearly double the average investment (Rs 5.89) of a plant. That means, one can recover one's investment amount almost in a year.

Plant Owners' Opinions and their Activities

The plant owners do not send samples of water for a detailed laboratory testing at regular intervals. The TDS content of the raw water varies from 800 to 2000 ppm, the TDS of output water ranges from 150 to 300 ppm and Fluoride content is 0.26 to 0.50 mg/litre. In the RO system, 30 to 50 per cent of wastewater is generated while processing the raw water.

According to of the plant owners, regular short time testing of raw water is un-necessary, for they argue that the quality of the raw water does not change often if the supply source remains same. With regard to expansion of their plants, most of the plant owners said that they would expand the capacity of their plants if the demand for treated water increases. However, many of them have excess plant capacity and expressed the view that with the ISI mark made mandatory, they may be forced to increase the price of the treated water leading to the possible decline in the

demand for treated water. Coming back to the 14 plants surveyed, we know that these plants cater to only 4890 families. If we take the average family size to be 5, then these plants would supply 'good' water (better than the water supplied by the municipality water) to 4890 x 5 = 24,450 persons approximately, which is only 3.41 per cent of the total population of the area where plants are situated.

Consumer Scenario

We have interviewed 60 consumers' families who form the clientele of the 14 plants as shown above because they live in the same city/town where the plants are situated. These 60 families together have 300 members, with 5 members per family on an average. Among the 60 respondents, 53 are males and 7 are females. The average age of male respondents is 43 years and that of female ones is 35 years. Twenty-two of these are businessmen, 4 self-employed, 22 belong to the service sector, 6 doctors, 3 housewives, 2 farmers and 1 student. Forty respondents are postgraduates, of which 27 belong to arts or science, 13 to engineering, 18 educated up to SSC/HSC, and only 2 have not completed schooling (non-SSC).

We found quality of consumers -- educated people and professionals well-placed in society in all these places. This is the reason why they are conscious about mineral or packed treated water.

Consumers' Opinion about Mineral Water

Fifty of 60 consumers felt that the taste of the water was good. Most of the mineral water buyers (49 of 60 families or 82 per cent) were from the income bracket of above Rs 5,000 to Rs 20,000 per month; more precisely, 34 of 60 families or 57 per cent were from Rs 10,000 to Rs 20,000. Thus high-income groups buy mineral/packed drinking water for good health and others only when they are forced to buy it.

On the question of ISI mark, 46 or 77per cent families said that the mark should be made compulsory but 36 or 60per cent were not sure whether merely doing so would guarantee quality. However, 46 families were hopeful of getting better quality water after the introduction of ISI mark.

Eighteen families thought that there was improvement in and even recovery at times in case of fluorosis affliction if they took the treated fluoride-free water with recommended amount of fluoride. Fifty-one families asserted that they would take this water for health reasons, and 7 said they would do so for taste if only because the municipality water was bad in taste. There are persons who reported that they got relief from the ailments like constipation and urinary tract infection etc after consuming RO treated water.

Conclusion

The market for the mineral/packed water produced by 'cottage' type industries has developed very rapidly in Gujarat between 1996 and 2000, especially in North Gujarat. The water packed pouches has more margins as compared to big-packs of 10 or 20 litres. The price of 10-litre packaged water for the year-round customers is Rs 1500, or Rs 4.11 per can. One pouch of 250ml has the ex-factory price of Rs 0.30 and MRP is Rs 1.00. Producing packed water in pouches requires only an additional investment in packaging machine, which the investors find affordable as it costs approximately Rs 1 lac. The packed drinking water in pouches has a large market catering to the people at large as it has 'any time, any place' type of market spread.

As long as the municipality's supply of ground water in North Gujarat is high on TDS and has more than recommended amount of fluoride, packed drinking water has a good market. People will spend for good water for the sake of health and often to avoid doctor's fee. Many people are spending extra for the sealed packed water or chilled insulated plastic can etc.

There is very good growth of this 'cottage' RO industry as the market is very wide. Even if the ISI certification is made mandatory, there is good number of investors who would not mind to invest the extra amount required for the ISI certification, as they know about the quality consciousness of their clientele. In reality, there are two among the 14 plant owners have started doing the initial planning of their new plant as per ISI specification.

Report

Fluoride-Free Drinking Water Supply in North Gujarat:
The Rise of Reverse Osmosis Plants as a Cottage Industry

An Exploratory Study

Background

Drinking water is a 'delicate' issue and the need for the 'purity' of drinking water is well known. What is not so well known is the degree of purity, which it must have for human consumption, and even it is known, not many users the world over are aware of it. Awareness of this notwithstanding, it has become difficult to continue conforming to the requirements.

Drinking water comes mainly from the rivers or from the existent groundwater. Excessive withdrawal of groundwater for domestic and agriculture purposes has caused the water table to go down, making the water brackish due to salinity ingress.

With rapid expansion in groundwater irrigation and consequent depletion of groundwater resource, several new problems have emerged in Gujarat that require attention of public policy planners. Of particular import is the problem of fluoride contamination. Since tubewell water is the primary source of drinking water in most of the rural as well as the urban households, groundwater depletion has begun to pose serious hazard to public health. The fluoride content in groundwater has increased to as high as 25-35 mg/litre, especially in the summers in North Gujarat, and in parts of Saurashtra and has continued for the last two decades. A generation of rural population drinking such water has since begun to develop all manners of disabilities related to fluoride contamination.

Gradually, awareness of the hazards posed by fluoride has built and is growing among common people. Municipalities in towns like Patan and Sidhpur have explored a variety of alternatives to provide safe drinking water to their citizenry. However, none of these has proved sustainable. In recent years, private entrepreneurs have entered the fray and have begun operating small-scale Reverse Osmosis plants in the cottage sector to serve drinking water with permissible amount of fluoride to the middle and the upper income group households. One estimate has it that there have been more than 50 such plants operating in Mahesana district alone. This exploratory study has been undertaken to make a first cut assessment of this sun rise industry in Mahesana[1].

In the initial stage of this exploratory study, we found that there was hardly any research to fall back upon. So we decided to focus on the above background in order to the study the market catered to by the Reverse Osmosis (RO) plants serving fluoride-free water to the people of Mahesana district in North Gujarat in the 'cottage' sector. For the purpose of this study, we use 'fluoride-free water' to mean treated water containing prescribed quantity of fluoride and not completely 'fluoride-free'.

[1] Mahesana district had been divided into two districts namely Mahesana and Patan in 1997. Since we wanted to restrict our study to old Mahesana, we covered both the present Mahesana and Patan districts. The rest of the text shall refer to it only as Mahesana district, meaning the undivided old Mahesana.

This exploratory study took us to places like Ahmedabad, Kadi, Mahesana City, Visnagar, Unjha, Bramhanwada, Sidhpur, Khali, Methan, Patan, Chanasma, Dharmoda, and Ismailpur, and also Baroda and Bhavnagar.

During our first visit we came to know that there were nearly 42 plants in Mahesana district alone but Mr Bharatbhai Patel, Vice-President of All Gujarat Packed Drinking Water Federation told us during our second visit that the latest figure of working plants hardly comes to 25. We wanted to cover as many plants in Mahesana as possible in our study and are happy to report that we have covered 14 plants of the district.

A large number of plants have closed down in Gujarat after the government circular dated 29th March 2001 making ISI mark compulsory for this 'cottage' RO industry, which has led to a conflict between the government and the industry. This has put a big question mark on the survival of this sunrise industry, especially the units engaged in manufacturing water packed in pouches. Hundreds of plants in Gujarat have closed down in its wake. We were not aware of what the ISI-issue has done to this industry so much so that we felt constrained to take it up for a separate discussion with every plant owner we visited, and this constitutes a separate section of this report.

Objective

The objectives of this study:

1. To make a broad estimate of the number of Reverse Osmosis (RO) plants in operation in Mahesana district, their total capacity, and investments made.

2. To undertake a detailed study of 8-10 plants in 4-5 towns so as to understand their economics, volumes of business, prices charged, their modes of business, the nature and economic profile of their clientele.

3. To assess the future prospects of the industry, especially focusing on growth rates on the basis of discussions with plant owners, customers, municipal leaders etc.

4. To bring out an overview paper in the manner of a quick industry study, which would also help us in identifying questions for interesting further research in this field.

Methodology

The methodology followed:

1) Detailed interviews were conducted and information collected through a structured questionnaire (Annexure –1) administered to a select list of 14 RO plant owners, owning plants of different sizes and capacities, spread over 8 towns in undivided Mahesana district to make a broad estimate of RO plants in this area.

2) Open interviews with municipal officials in GWSSB office at Patan, NGOs and village Sarpanchs in Ismailpur near Chanasma and Methan near Sidhpur.

3) A structured survey (using a questionnaire given in Annexure – 2) of 60 customers was conducted to develop a socio-economic profile of the market segment served by the cottage RO industry in the above 8 townships, where the plants are located.

RO or Membrane Technology for Purification of Brackish water

The process of purification of water has been used for long particularly for desalinating seawater. Those processes can be classified into following groups: 1) Distillation, 2) Freezing, 3) Humidification, 4) Chemical, and 5) Membranes. There are several techniques available under each one of them. For example, Long-Tube-Vertical (LTV), Multi-Stage-Flash Distillation (MSF), Vapour Compression (VC) and Multi-Effect-Multi-Stage-Flash (MEMSF) are based on distillation. Under freezing process, there are direct freezing and secondary refrigerant; under humidification – solar and diffusion, under chemical – hydrates and ion exchange (IX) and under membranes - there are reverse osmosis (RO), and Electrodialysis (ED).

The MSF had been the most popular one among the various technologies available for desalinating saline water till 1980s, when RO had started gaining ground gradually. With continued research and development efforts in membrane materials and performance improvement, especially after 1980, dawned a new era in seawater desalination using RO technology. This resulted in rapid growth of RO technology and in the second half of 1980, it became a competitive one for future. Later, it captured 88per cent of the total installed capacity of desalination plants world over.

In 1990, RO technology was used to treat more than one billion gallons of water per day, and this market was expected to grow by about 18 per cent a year for the rest of the century (CSMCRI, 1997, pp. 121-2). However, during the period between 1993 and 1995, RO became the most popular of all the desalinating processes. The use of MSF process declined in 1981 and fell to a low level in 1988. It again recovered in 1993 with a very high share of 62.3per cent, but only to decline again to a very low share in 1995. Consequently, RO has gained a considerable part of the market, amounting to 88per cent in 1995 (CSMCRI, 1997, p 54).

RO-based desalination is a mature industry today. Its desalination capacity has increased greatly in the last twenty years. According to a study of CSMCRI, Bhavnagar this technology has improved so much that system has increased recovery of up to 50 per cent through an operating pressure at 1,200 psi. Secondly, energy requirements have been reduced from 30kwh/1,000 gallons approximately, to less than 18 kwh/1,000 gallons. Thirdly, the costs of RO plants have been reduced to nearly 50 per cent in the world market between 1979 and 1991. This study also notes that there is a potential for growth in this industry of up to 15 per cent compounded of the total installed RO units (CSMCRS, 1997, pp 71-72).

Osmosis and Reverse Osmosis: The Process

The principle of Osmosis and Reverse Osmosis is based on semi-permeable membrane science. Osmosis[2] and Reverse Osmosis are important diffusional processes through a semipermeable membrane, driven by concentration difference and pressure respectively. The natural force that drives the water through the semi-permeable membrane is called 'osmotic pressure', and the process is called 'osmosis'. The concept of Reverse Osmosis[3] came to light in the middle of 1950's and can be considered a need-based invention.

The Two Processes

Literally the two phrases signify just the opposite process, however thermodynamically they are similar. In osmosis, the solvent (water) flows to solution (salt-water) through semipermeable membrane, whereas in reverse osmosis, the flow of water is from solution (salt-water) to solvent (water) by applying pressure on solution (salt-water) side. In both these cases, only solvent (water) molecules migrate from one side to other.
The principle of RO is shown in Figure - 1.

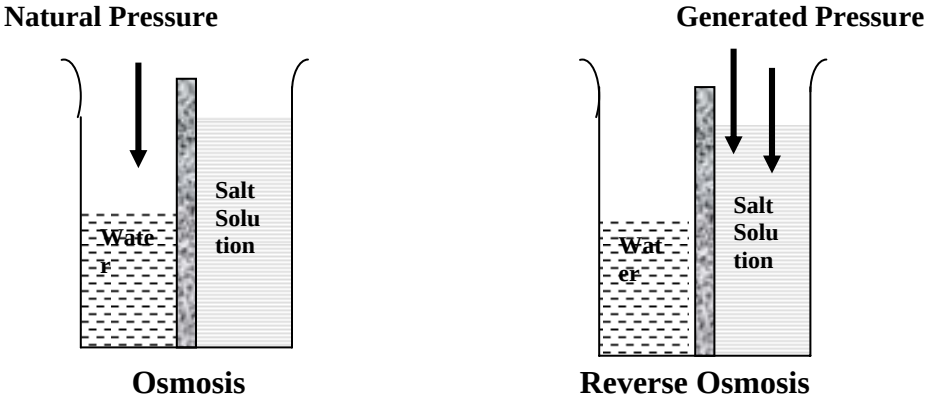


Figure - 1. Osmosis and Reverse Osmosis Process

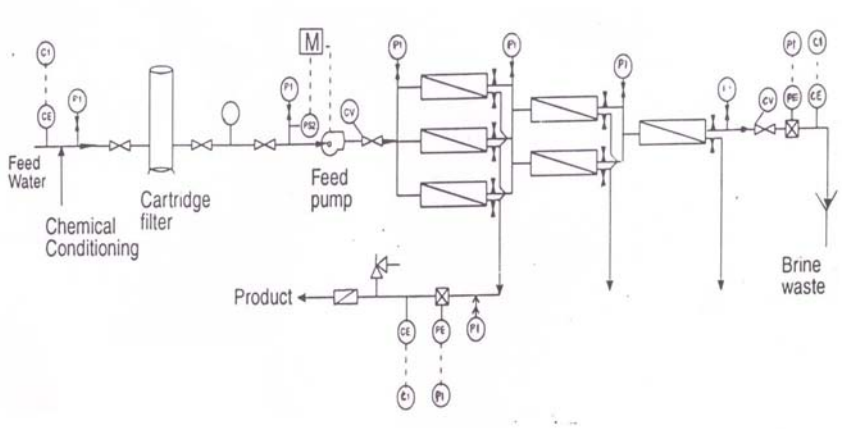
The RO Technology: A Development

[2] Osmosis is a natural process involving fluid flow across a membrane known over the last 250 years (Bhattacharya, 2001; pp 47-48). The term 'osmosis' was coined by the French Physiologist Henri Dutrochet 80 years after Abbe Nolet made the discovery of the phenomenon in 1748. Later on Van't Hoff established the scientific principle behind the process for dilute solutions. Osmosis is the process by which plants and animals survive because it is a regulatory process in cells of all plants and living beings. The photosynthesis mechanism for the plants operates due to the osmosis and it starts from the passing of water from the soil into the plants across the walls and membranes of the cells in the roots and root hair.

[3] Prediction by Samuel Yuster about the conversion of brine into water, based on its adsorption isotherm gave Loeb and Sourirajan a new direction. Among the followers in the field were Reid and Breton. With progress towards the modern civilization, and growth of industrialization RO has also registered growth due to innovative technology in this field (Bhattacharya, 2001, p 47-48).

Reverse Osmosis is a process that uses semi-permeable spiral wound membranes to separate and remove Dissolved Solids, Organic, Pyrogens, Submicron colloidal matter and Bacteria from water. Inlet water is delivered under pressure through the membrane, where water permeates the minute pores of the membrane and is delivered as purified water. Impurities in the water are concentrated in the reject stream and flushed to the drain[4].

A typical RO system consists of pre-treatment, high-pressure feed pump(s), an 3-2-1 array of membranes housed in pressure vessels, and a network of piping and valves to divide the feed water and collect the permeate product. The process utilises four different configurations, namely plate and frame, tubular, spiral and hollow fine fibre.
A typical RO system is shown in the Figure - 2.



CE = Conductivity Electrode
CI = Conductivity Meter
PI = Pressure Gauge
A = Differential Pressure Gauge
PS2 = Pressure Switch
CV = Control Valve
FE = Flow Sensor
FI = Flow Indicator
PE = Product Flow Sensor
PI = Product Flow Indicator

Figure - 2. Typical Reverse Osmosis System
[Reproduced from CSMCRI (1997), p. 42]

There are 3 layers in the RO membrane to make the typical spiral wound model: (1) Polyester non-woven fabric, which is highly porous, and is placed on (2) Polysulphane membrane, which is also highly porous (there is no rejection) and this is placed on the (3) Polyamide Polymer (this one has no porosity and is responsible for rejection). Thus a spiral wound model is made, which is now very much used in plants and is shown in Figure - 3. Dr P S Anand, (Sr. Scientist) and Dr (Ms) S V Joshi of CSMCRI explained this to us.

[4] Reverse Osmosis is capable of removing 90-98per cent of the Total Dissolved Solids (TDS), 99per cent of the Organics (Including pyrogens), and 99per cent of all Bacteria. Currently available membranes can eliminate as much as 99 per cent of the mineral content of the water in one pass. It is advantageously used to remove water from the concentrated solution. Since the cost of RO treatment increases very little with increased TDS, it is economically attractive for the desalination of both brackish water supplies at TDS concentrations of 10,000 ppm and seawater supplies at 45,000 ppm. Along with TDS RO process removes fluoride proportionately. If TDS is at tolerable level and fluoride content is high then one can use special alum-resin filter, works under gravitational force. This model is under experiment with Dr P S Anand at CSMCRI, Bhavnagar.

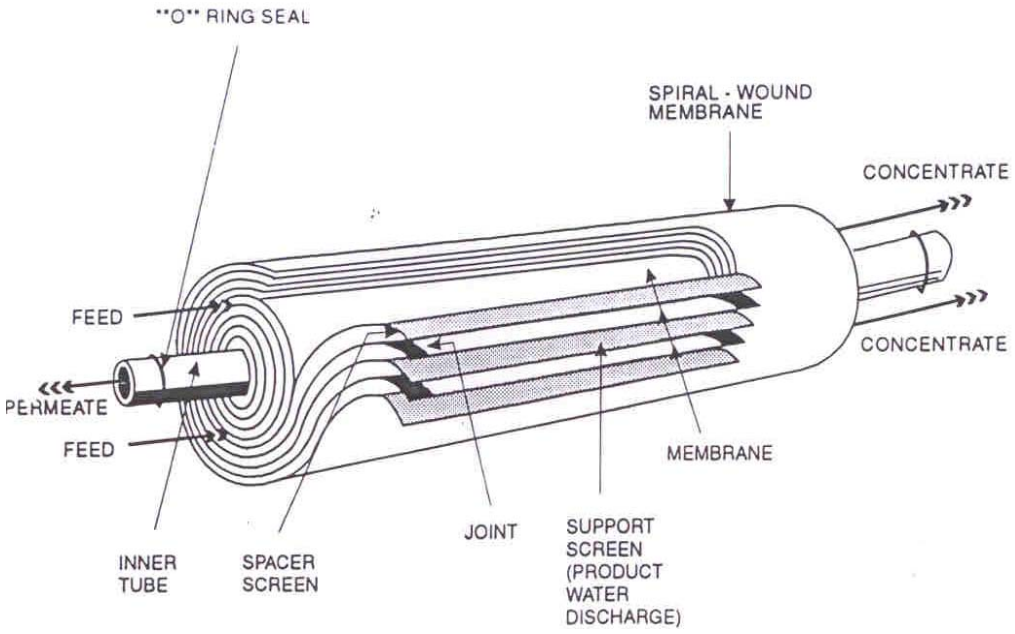


Figure - 3. Spiral Wound Module
[Reproduced from CSMCRI (1997), p. 128]

The pressure that has to be generated for RO plant is dependent on the capacity of the plant. The motor to be installed is on the basis of the capacity. For instance, in a 'cottage' RO plant, a 500 LPH plant would require a pressure of 8 to 12 kg/cm^2 for which, a 3.5 HP motor is to be installed. The electricity bill would be Rs 1800 per month if the plant runs 6 hours a day and 30 days a month, or just Rs 10 per hour. For a 1000 LPH plant 4.5 HP motor would be required, for 100 LPH it is 1.0 HP and for 250 LPH it is 1.5 HP motor.

A typical 'cottage' RO plant is shown in Figure – 4.

A = Stop Cock
B = Activated Carbon Block Filter
C = Granular Activated Carbon Filter
D = Anti-scalant
E = Auto Shut-off Valve
E = Auto Shut-off Valve
G = RO Module
H = Silver Impregnated Activated Cart
I = Wastewater Outlet

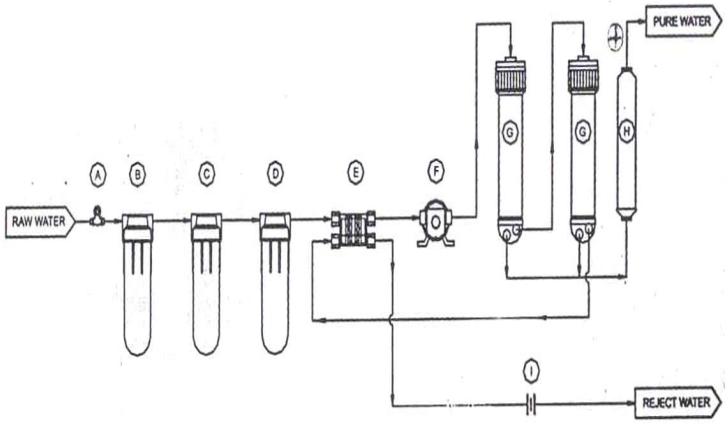


Figure - 4. A Typical Cottage RO Plant
[Reproduced from a leaflet of Permionics (India) Ltd]

Problem of Fluoride and Nalgonda Model

Fluorides occur naturally in many public water supplies and, when present in less than the required amounts, may give rise to dental caries in some children. If present in much higher concentrations, then may eventually cause endemic cumulative fluorosis resulting in skeletal damage in both children and adults.

Fluorides are also regarded as an essential constituent of drinking water, particularly with regard to the prevention of dental caries in children. If the fluoride concentration in the drinking water of a community is less than 0.5 mg/l, then the incidence of dental caries is likely to be high. To prevent the development of dental caries in children, a number of community water supplies are fluoridated to bring the fluoride concentration in the required range 0.6 – 1.2 mg/lit as given in Indian Standard Specification for Drinking Water, IS: 10500-1983 (CSMCRI Report, p.11) or 1.5 mg/lit (IS 14543 – 1998).

Though the Activated Alum based technique of Domestic and Public De-fluoridation systems are feasible and at times cost effective too, (Nanak Santdasani, 1997, p 6.34) it is not so fruitful for de-fluoridation. This system is 'erroneous one' and not 'desirable' also. This technique converts 'ionic fluoride' into 'soluble aluminium fluoride complex ion' which removes only a smaller portion of fluoride ion as precipitate. The presence of fluoride in 'complex aluminium fluoride anion' can not be detected by usual testing method and this leads to believe the absence of 'fluoride' in water. The technique converts a greater portion of ionic fluoride (67–82 per cent) into soluble Aluminium Fluoride Complex ion, but in actual terms removes only a smaller portion of fluoride ion (18–33 per cent) in the form of precipitate. It is only due to the limitation of the fluoride electrode method to detect fluoride present in the Aluminium–Fluoride complex ion, one could be misled into believing that these filter alum remove fluoride from water to a great extent. In view of the toxicity of aluminium fluoride complex ion as well, it is concluded that Nalgonda technique of de-fluoridation of water is not desirable (Apparao et al IJEP, 1990, p. 292).

Government in Large Scale De-Fluoridation Plants

Some cases cited here in brief, like that in Ismailpur in Patan, Methan in Sidhpur and in other places, where public system of de-fluoridation plant and plant to supply 'good' water were installed but failed to continue after one or two years. The failure mainly due to operational difficulties and management failure, or funding or simply the people are apathetic to understand the severity of the fluoride-caused diseases. For a detail story see Annexure –3.

In **Ismailpur**, it was a twin-village project between Ismailpur and Sojintra in Chanasma taluka in Patan division of the undivided Mahesana district. The plant was designed following Nalgonda model and installed by GWSSB in 1999. It had a capacity of 100 M^3/day (1,00,000litres/day approx.). The cost of construction was nearly Rs 9.34 lac. The maintenance cost for the Ismailpur-Sojintra joint plant, worked out on the basis of the average maintenance over a period of three years, was Rs 3,10,000 per year for a population of 2,805 (according to 1991 Census) in two the villages put together. Thus, it is nearly Rs 110 per person per year, which means 0.30

paise per person per day. Unfortunately, this plant has remained closed for the last one year. The Sarpanch of Ismailpur told this investigator that people were not interested in spending on water. The Deputy Executive Engineer of GWSSB, (which is under Department of Health in Government of Gujarat) said that the project initially maintained by the Government was to be handed over to the village authority after installation. The Government can not continue to bear the burden of maintenance forever. Moreover, the beneficiaries should also share the cost. The Sarpanch's argument was that the government should continue to finance it. In Chanasma taluka, 70per cent people are suffering from fluorosis! Most interestingly, Ismailpur has a very big newly constructed school and a Marriage Hall of latest design in granite finished stone, just at the entrance of the village. It was difficult to understand people's response to fluorosis. May be, it was sheer callousness of the people towards health.

Take the case of **Methan** village in Sidhpur taluka, which is 17 kms away from Sidhpur City. Methan has a Nalgonda kind of De-Fluoridation plant with a capacity of 30,000 litres per day. This is one of the first plants of its kind established in 1997. It runs on the same Nalgonda technology using Alum-based resin. For the last seven months, it has remained closed. The people of the village are awaiting water from Dharoi reservoir, which has already come up to Kakoshi village – seven kilometres from Methan. Enthusiastic as they are, they have forgone the use of treated water from the plant.

The village has an Aga Khan Health Service (AKHS) Centre because AKHS has adopted the village for its health services. People who are Ismaili Bohras and Hindu families populate it. Ismailis are less than the population of the Hindus, they live amicably and take part in each other's social activities. They also share good and bad times together. It has a population of 3,200 on record but many of them have migrated from here. So actual terms, the population is only 2600 strong now.

There were 244 members buying water from the plant. Of these 244 members, 150 used to buy 10 litres a day and 94 bought 20 litres a day. These 150 members are from a total of 285 Ismaili families of the village. The income work out to Rs. 5820, which was sufficient to cover the operating cost leaving some savings if the fees were received regularly. The plant was a Resin-stone layer filtration plant washed by Alum-solution from time to time. The operator used to mix a fixed dose of Alum-solution of 100 litres for 30000 litres of water. The resin was also recharged from time to time. This plant was made by Indian Ion Exchange Bombay and was managed by Muniavarbhai Chunilalbhai Trust.

This de-fluoridation plant was set up in this village in 1997 at a cost of Rs. 1,05,000 plus other cost of Rs.25,000 taking its total cost to Rs. 1.30 lacs. The capacity was 30,000 litres. The operating cost was Rs.3,000 per month including a salary of Rs.2000 per month paid to the operator and Rs.1000 per month for chemicals like resin, alum etc. Twenty litres of water a day was sold to people of the village at Rs.30/- per month and 10 litres a day at Rs.15/- per month. They had to carry water from the plant by themselves.

The village has people suffering from many types of water borne diseases like typhoid, cholera, gastro-intestinal disorders, hepatitis/jaundice, dental problems, malaria, musculo-skeletal diseases (fluorosis/gout etc). The numbers of cases as found in the MIS reports of AKHS Centre

in the village are shown in Table No – 1 of Annexure -3. The Report of AKHS shows that more of Ismailis suffer from Musculo Skeletal Diseases (MSD), which includes fluorosis, gout etc. Hence, they use more de-fluoridated water than others. During Oct.- Dec., 2001, MSD patients in AKHS centre of Methan consisted of (108 M + 108 F) or 216 among Ismailis and (48 M + 82 F) or 130 among Non Ismailis (Table-1 of Annexure-3).

The plant has remained closed for the last 7 months in the expectation of water supplies from Dhorai Dam. This has not happened to date. The pipeline has reached up to Kakoshi village, which is about seven kms away from Methan. The people of Methan are very optimistic even they are in severe poverty[5].

Only younger people suffering from fluorosis in its initial stage take de-fluoridated water. Even this group has been deprived of de-fluoridated water for the last seven months. Some of the victims are beyond recovery and do not benefit from the supply of de-fluoridated water[6]. This may be one of the reasons why they are less interested in continuing to run the plant.

Dharmoda village in Chanasma taluka has two tubewells and a tank with the capacity of 5,00,000 litres potable water supplied to 12 villages. Each tubewell is 510 feet deep. Water from these is supplied after making it more palatable by mixing chlorine salt. The water is supplied 4 hours a day. We took a sample of water of this well and found no salty taste. The distance of the farthest village is 28 kms from the source of this tubewell. They say that there is no fluoride in the water of these tubewells. There are 6 tubewells of this kind every 15 kms in a line in Dharmoda, Lanwala, Pinpal, Modhera. Dharmora's 2 tubewells cover 12 villages. They have already set up a water filter/treatment plant, which will be used when the Narmada Water reaches there. A chlorine gas unit has also been set up for making chlorine solvent so as to make water potable at the outlet for supply to this village. 10 litres of Chlorine salt is used per 5,00,000 litres of water.

With an approximate population of 25,000, these 12 villages get their drinking water supply from these tubewells and the same water is available for their animals. Interestingly, 5 of these 12 villages (Bramhanwada, Samisha, Chapwada, Suraj and Adiwada) recently, do not use the water from these tubewells. People of these villages have their own private tubewells, where the water may have more TDS according to Works Assistant, GWSSB, Dharmoda, Chanasma.

There are **12 large Government RO plants** (11 of them are commissioned) in different places of Gujarat. Their capacity ranges from 10 M^3/day (ten cubic meters per day ie 10 x 1000 litres = 10,000 litres per day, approx.) to 100 M^3/day, ie one lac litres per day. Out of 11 plants, 10 were commissioned in 1990 and 1 in 1992. The twelfth one was dropped at its installation in 1989.

[5] According to Smt. Hansaben, the nurse at AKHS centre of Methan, who has been working there for the last twelve years, Hindus find it less affordable to use this treated water. "There are people among Hindus who take only black tea for their dinner" and "they survive with the support of their neighbours" said Hansaben. Invisible poverty is too high in this village.

[6] The tank system is not sufficient enough. The operator, Shri Saiyad, opined that as against raw water fluoride of 1.7 mg/litre, the treated water fluoride is 0.6 mg/litre. Shri Saiyad also told us that more of Ismailis use this de-fluoridated water than of the Hindus. All these factors seem to have contributed to people's lack of interest in using water from the plants.

Interestingly, out of these 11 plants, 4 have stopped working since 1992. Government report says that the reasons of 'not working' were either high TDS in the raw water used or insufficient supply of raw water (CSMCRI Report, 1997, pp 93-95). Since there is a drop in the supply of potable water in different places in Gujarat, entrepreneurs used this opportunity to supply potable water made through smaller capacity Reverse Osmosis plants in order to cater to the needs of the people within their domain of operation.

Bramhanwada, a village, has nearly 60per cent of its population suffering from fluorosis, and these people feel better after using mineral/treated water and some have got cured after using the treated water. It is success a story of using water from RO Plant. However, the people of Methan could not get cured. In Methan, possibly, the ineffective working of the Nalgonda method of de-fluoridation owes itself to an erroneous mechanism as told above. People believe that if the water is changed, there are chances of reversing the process. They practised it on their own, and some people this investigator met, have been cured absolutely of their fluorosis affliction though the marks remain intact. In other words, it is clear that if the damage due to fluorosis were not severe then there would be a possibility of reversing the process. This village is not very far from Methan. It is on the highway between Unjha and Sidhpur, provides an example of how this is so.

Reasons of failure and success:

1. **Ismailpur:** Besides possible in-effectiveness of the Alum-based plant, there are reasons like lack of initiative, less fund, 'Government is to do all' idea and people's apathy to understand the severity of the fluorosis or water borne diseases.
2. **Methan:** The lack of strong management, expectation to get Dharoi water and ineffective result even after using the de-fluoridated water.
3. **Dharmoda:** There may be some political reasons that led to stop the use of 'good' water supplied by the Government.
4. **Other 4 big RO plants:** Initial Investigation of Raw Water was not done and later it was found that the Raw Water was too brackish to the capacity of the plant. Thus plans were left idle.
5. **Bramhanwada:** The success story of removing fluorosis after using water from 'cottage' RO plants proves the effectiveness of RO treated water.

Thus, a market for the production of de-fluoridated water with less TDS by 'cottage' RO plants came into existence.

RO Plants from Large to 'Cottage' Industry and to Domestic Kitchen Use

We now know that the RO technology is being used widely in industries like textile, dyeing and paints, edible oil, fertiliser etc, for they need TDS free water for their boiler and for their product-wash. Besides these, RO plants have been established in the coastal areas, where there are coastal habitats in different states of India for desalinating huge quantities of seawater. Several plants are being designed and commissioned indigenously in India in consultation with the CSMCRI at Bhavnagar. The process was initiated in 1970s under the leadership of Dr Surairajan and his team.

In our discussions with Dr P K Ghosh, Director of CSMCRI, we came to know the extent of research done in the field of RO. The CSMCRI, have now designed a plant to be run by a pair of bullocks, and this was to be demonstrated on the day after we had visited them. Bullocks are not much in use in summer, when agriculture operations come to a halt, because human consumption of drinking water is greater.

Recently, Softel Marketing (P) Ltd and Permionics (India) Ltd. have come up with 'MinerWa', 'Lo-Sal' and 'Perma Pure' respectively. These are small machines that people of middle and upper middle income group can afford for the purpose of getting pure drinking water at home in their kitchen since these use the RO system. These are domestic kitchen plants.

Growth of Manufacturers of RO Plants

The manufacturers of RO plants started producing plants for small industries in the 1980s. It was during this period-between 1980 and 1984 that Parle (Export) Ltd., Bombay took the initiative of marketing mineral water under the brand name of 'Bisleri' in PET [Polyeutherine] bottles. This was the beginning of a new market of 'packed drinking water' in India. Then Kothari Products Ltd started marketing packed drinking water under the name of 'Yes' in 1990. Looking to the spread of the market, they started giving franchisees to businessman in different places in Gujarat as well as the rest of India. Coca-Cola and other soft drink giants established factories or gave their 'good will' on lease. During this time, only one-litre bottles and jars of twenty litres were available.

There were only 3 or 4 Reverse Osmosis and membrane plant manufacturers in India till 1995: Ionexchange in Bombay, Thermax in Pune, and Doshi Ionexchange in Ahmedabad. Currently, there are as many as 16 plants in India (CSMCRI Report, 1997, pp 117-8). The membranes were imported earlier from 4 manufacturers in the USA namely, Osmonics, Hydronautics, Filmetech and Koch. Similarly, the pump manufacturers were also only three: KSB, Pune, DP, Duch Primepaur, and Gruandfoss, Germany.

Growth of Market in Gujarat

The growth of RO plants in cottage sector in Gujarat reached its peak between 1997 and 2001. Smaller capacity RO plants were designed on the one hand and packaging system were developed on the other. Liquid package system, started in milk sector, helped the water sector too. Those occupied in producing mineral water found their market only in Jerry can of 10 and 20 litres. Later, with the introduction of packing machine for water pouches, people started producing pouches of 250ml.

Pouches have their own market segments. It is available in the selling points like bus stops, railway platforms, railway level crossings, highway crossing, and '*pan ka galla*' (beetle shop) depending as it were on heavy and fast movement of population and high temperatures. Very young boys at these selling points generally sell the pouches. Pouches have a better margin also. The ex-factory price varies from 26 to 30 paise per pouch for the distributors. The distributors sell them at 35 to 40 paise per pouch to the retailers. The MRP is Re 1.00 per pouch. The vendors generally sell these pouches after chilling, and these cost them separately. So a sales-boy gets nearly 60 paise per pouch or 50 paise if he has to bear the chilling cost. The pouch market is

very big in places like Mahesana city, Unjha, Sidhpur, Surat, Rajkot etc. Pouch buyers are generally on the move. They just buy from roadside shop or from a moving vendor. Buyers are also from groups of labour, who are working in construction of a road under the scorching sun during the summer. They just can not afford cold soft drink and have to make do with water pouches priced at Re. 1 chilled. This is true even of small township or villages. Maybe, the idea generated from coloured sweet water available in plastic pouches which children called 'pepsi' in the village market. It has a good demand in the villages in summers.

Surat has to cater to a high demand for chilled mineral water in PET-Bottles of 20-litres with a dispenser or in insulated pet-jar or insulated jar fitted with a tap instead of pouches. The logic in it is that Surat has a multi-storeyed textile market with nearly 20,000 shops. There is no sufficient drinking water of good quality for clients and shop owners. The owners come from a distance. Many of them come by two-wheelers and bringing water from home during summer is a tedious job. So they prefer to have the supply of chilled water both for themselves and their customers. They purchase 20-litre chilled jug manufactured by a local beverage company at Rs 13.25 every day. For a branded like Parle's 'BailleyAqua' of, the price is Rupees 45. So people go for the one manufactured and packed locally[7].

The small size plant of RO unit started coming to the market from 1995. And this was the time when pouch-packing machine was also marketed. Combined together, they ensured the growth of cottage size mineral water manufacturers especially in the area where healthy drinking water was not available. Between1997 and 2002, there were 300 plants of this kind. After the publication of a circular from Bureau of Indian Standards dated 29 March 2001 which made ISI certification mark compulsory, and proposed an in-house laboratory, the smaller plant manufacturer water packed in pouches have started closing down, particularly units producing pouch packed water. Now, the number of active plant producing packed water including pouch-packed water is less than hundred.

There is a seasonal variation in the product of this industry particularly for the pouch-packed water:

1. January, February is the off season (cold wave reduces demand).
2. March, April, May, June is the peak season (severe hot summer).
3. July, August the demand goes down after the first shower in the monsoon season, for groundwater becomes better after the showers.
4. September, October, November enters, demand remain normal.
5. December is absolutely the off season.

This is possibly true of the demand not in the households but outside that is for pouches or bottles. Where water quality is not good for household consumption, the demand remains almost constant, changing at the most by 20 per cent so there is a standard demand throughout the year.

[7] In Surat textile market alone 15,000 jugs of water are sold everyday on a very conservative estimate. In other words, (20x15,000) = 3,00,000 litres of mineral water is required everyday. In term of cost this works out to (Rs. 13.25x15,000) = Rs 1,98,750. Moreover, nearly 6,00,000 litre of raw water is required to produce 3,00,000 litres of mineral/packed drinking water. This is the volume of Surat market in a day.

This way, the 'makers made their market' for treated or mineral water as they grabbed the opportunity of catering to their respective market segments.

Making ISI Mark Compulsory

The President of All Gujarat Packed Drinking Water Federation, Dr Firdosh R Mahuvawala, gave us a part of the above information. He also told us that there were 300 manufacturers of packed drinking water in Gujarat until a few months ago. The largest number of small plant owners came to the market in 2000–01 (50per cent of 300 plants). This has reflected also in our field survey. More than 200 units have downed their shutters after the announcement making the ISI mark compulsory for packed water irrespective of whether it was marked in pouches or in bottles. However, there is a loophole in the law. If the Jerry cans or tap-fitted cans are not sealed, then it is not compulsory to get a separate certificate from Bureau of Indian Standards (BIS) for ISI mark. This has not posed any problem to the large producers like Parle, Kothari, Pepsi etc. For the small producers, it has become a big problem. They have to invest a large amount of money in the margin of, Rs 3 to 4 lac for an in-house laboratory, plus a fee of Rs 84,000 a year. These are compulsory for ISI certification. Thus currently those who are in business have to invest this large amount of money immediately. A small manufacturer today has to invest Rs 4 lacs to start a new plant. He would need an extra amount of Rs 4 to 5 lac for his in-house laboratory etc for getting ISI certification to start a new business, taking his total investment to Rs 8 or 9 lac approximately. The ISI standard would require Rs 7 lac even for a small capacity plant of 500 LPH with a set up of in-house Laboratory etc, instead of was Rs 3 lac as it was earlier. Out of 300 cottage plants, 10 plants can go for ISI standardisation while the other 290 may have to go out of business according to Dr Firdosh.

"The new quality standards laid down in the final notification by the government for the bottled/mineral water industry are in the line with the international standards" stated Minister of Health and Family Welfare, Dr C P Thakur, while addressing the seminar on Mineral/Bottled water organised by the Confideration of Indian Industry (CII) in New Delhi published in a Press release of CII website (Ref. http://www.ciionline.org/news/pressrel/2000/oct/05101.htm). This notification was made for consumers' interest and for the public health, the Minister added.

The Minister also commented on the differential behaviour of the Indian manufacturers following codes of hygiene. While exporting their goods they follow strictly the codes of concept of Hazard Analysis Critical Control Points (HACCP) ensuring quality of the of the end product, 'but tend to deviate from these standards for the domestic market', Dr Thakur candidly stated.

According to Mr Inderdeep Singh, Chairman, CII Small Industry Committee owing to increasing urbanisation and industrialisation, the mineral water Industry is expected to grow at a phenomenal rate of 25per cent per annum in coming years.

CII Chairman argued that making ISI mark mandatory is to align the national standards under BIS/PFA for the bottled water sector as the standard under Prevention of Food Adulteration are deviating from the BIS and international standards. He further added that 9 out of 12 known brands were found to non-conforming to BIS/PFA standards.
(Ref. http://www.ciionline.org/news/pressrel/2000/oct/05101.htm)

In the United States, since 1938, the FDA has regulated bottled water as a packaged food under the Federal Food, Drug and Cosmetic Act (FFDCA). International Bottled Water Association (IBWA) aims to assure that safe, clean, good bottled water is produced and marketed to consumers.

One can get a typical description/definition of Indian Mineral water, Naturally Carbonated Natural Mineral water, and Packaged Drinking water (other than Mineral water) in detail from the book entitled 'The Prevention of Food Adulteration Act, 1954 amended till 2001', 2002, pp 223-229.

With the BIS announcement making ISI mark compulsory dated 29th March 2001, just three days after, came the All Gujarat Packed Drinking Water Federation, which was established on 1 April 2001. This investigator was told by some of the plant owners during their interview that they were given the choice of either remaining under Prevention of Food Adulteration (PFA) Act or getting the mandatory ISI mark by the Food Commissioner of Gujarat, at a meeting in Gandhinagar. These beverage companies are already registered licensees under the Prevention of Food Adulteration (PFA) Act. They are now busy rethinking on the issue taking into account the costs involved in fulfilling this new set of conditions.

Truly, it is not only the cost that matters to them they are also worried that it does not give much guarantee logically of the quality of product. If that were so then there is the PFA already in place for enforcing quality booking the culprit. Since the laboratory is in-house, no one would be willing to concede that one's own product was bad or not up to the mark. The opponents' arguments are:

(a) why there should be two agencies appointed to determine the quality of single product;
(b) the in-house laboratory is not going to be used for more than two hours a day, and if that were so, where was the need to go make such a large investment; also this being so,
(c) it would be better to set up one laboratory for a group of plants, so that the amount of investment can be shared, and
(d) would recovery of the cost of the laboratory be possible by increasing the price. They fear that there may be fall in sale.

The proponents are thinking of a bigger market in the future for their product with an ISI mark.

During our meeting with the consumers, we found that they were not very sure whether the ISI mark could guarantee them quality. Many of them referred to cases of AGMARK ghee and honey, which is a sham where guarantee of the quality is concerned. Of course, many agreed that the need for ISI mark would put the manufacturers under pressure to guarantee quality, because a 'strict' law makes the people more competitive. Some of them were even ready to pay more if the product had ISI mark.

The policy of making ISI mark mandatory would benefit the MNCs as they have already a big market and established infrastructure. The supply of water provided by the Government or local bodies is worse in quality than the water in pouches. What is wrong with the pouch is the plastic used in the manufacture of pouches, for many a time bad quality plastic is used to make pouches. Also some plant owners may not have paid attention to the quality of the product, interested as

they might have been in doing brisk business during the summers. Imposing control through the setting up of 'high-cost-laboratory' by BIS would mean throwing small-scale and cottage industry of water out of business. However, this may help the 'fittest survivor' in the long run.

The Exploratory Study in North Gujarat

The 'mineral' water[8] is being sold in the market under different brand names (eg *Bislery*, *Aquafina,Yes*, *BailleyAqua* etc) for the last so many years. Available in bottles and Jerry cans, this is produced by large industries like Parle, Pepsi etc. People install *Aquagaurd* with Ultra Violet Ray (UV Ray) treatment at home to get clean and bacteria free water. Recently, Softel Marketing (P) Ltd and Permionics (India) Ltd. have come up with 'MinerWa', 'Lo-Sal' and 'Perma Pure' respectively. These are small machines that people of middle and upper middle income group can afford for the purpose of getting pure drinking water at home in their kitchen since these use the RO system. These are domestic kitchen plants.

This is only one side of the story. However, for the last few years 'cottage' size RO plants have come to cater the people of middle and upper middle income group, who can afford to buy mineral water supplied in 10 and 20 litre in Jerry cans, however, may not invest on kitchen model of RO machine. The plant owners also supply 250 ml pouch packed water as well, with the product and manufacturer's names printed on it, for those who are on the move out of home and can not buy a bigger pack of water. They have their own market segments.

This research project made an exploratory study of the ground realties in the market for mineral water. We visited 14 plants and collected structured information from plant owners and met 60 consumers to get their opinions in structured form about the drinking water that they buy. All plant owners produce mineral water and sell it mainly in Jerry cans and in pouches. We gathered from our survey that there is a huge business potential for this industry, since many people are health conscious and can afford to buy this water and as long as the municipalities can not supply safe and good water for the people.

The Undivided Mahesana District

The Mahesana district derived its name from the town of Mahesana. It is said that Mahesaji or Masaji, a ruler in the Chavda Dynasty, founded Mahesana. Patan, the other division of the district (now a separate district), was once upon a time the Capital of Gujarat for over 600 years between 8th and 14th centuries. This district enjoys special importance in North Gujarat. It has a lot of historical places of importance including the Sun Temple of Modhera, which is as famous as the eastern one in Orissa.

The population of Mahesana is 1,837,696 with 954.006 males and 883,690 females (Census 2001). In case of Patan, the population is 1,181,941 with 611,486 males and 570,455 females (Census 2001). The average literacy in Mahesana is 75.54 per cent (males 86.52 and females

[8] During the process in the RO plant the raw water becomes actually de-mineralised but at end of the process the treated water passed through activated carbon and impregnated silver to make water more 'organoleptic' and hence, it is called as 'mineralised' or 'mineral' water.

63.96 per cent) The corresponding figures for Patan are 60.59 per cent (males 74.06 and females 46.36).

The water of Mahesana is brackish and salty. We have presented here the quality of water from a tube well with a depth of 670 feet in Methan (Sidhpur Taluka), where Fluoride content was 1.70 mg/litre and TDS 1068, in April, 2001.

Analysis of the Field Data

We have collected information from 14 plants in Mahesana district focussing in the mainly on their Identification, Customer Base, Production, Plant Capacity, Operating Cost, Wages, Distribution Costs. We collected also some other information especially the opinion of the plant owners on the issue of ISI certification, other problems (if any), and the plant owners' willingness for expansion in future. The Structured Questionnire II, have used for interviews with plant owners is enclosed (Annexure - 1). We shall discuss the data collected under the head **Plant Scenario.**

We have also collected data from 60 consumers of the same district mostly from the same locale where the selected plants are located. Besides their Identification, we collected from them the Product Profile they use, their Usership and Awareness of the Product, their opinion on the issue of ISI certification, Awareness of Fluorosis, Taste of water, and lastly their monthly income bracket. The Structured Questionnaire I used for consumers is enclosed (Annexure - 2). We shall discuss their responses under section **Consumer Scenario.**

Plant Scenario

Out of these 14 plants from which we collected the data, 4 are in Mahesana, 3 each in Unjha and Patan, 1 each in Kadi, Visnagar, Sidhpur, and Chanasma. The plants of Visnagar, Sidhpur, Maktupur (Unjha) and Chanasma are situated in rural areas and cater mostly to the needs of their rural clientele (Table-1).

Table-1: Location of Plants, Nature of Company and Year of Establishment

Items	Description		No. of Plants
No. of Plants Visited in Places	Mahesana	=	4
	Unjha & Patan	=	6 (three each)
	Kadi, Visnagar, Sidhpur, Chanasma	=	4 (one each)
	Total Plants	=	14
Nature of Company	Partnership	=	5
	Proprietorship	=	9
	Total Plants	=	14
Year of Establish ment	1996	=	3
	1998	=	2
	1999	=	2
	2000	=	4
	2001	=	2
	2002	=	1
	Total Plants	=	14

Source: Field Data

However, the plant of Khali (Sidhpur) is situated in rural area and sells water in pouches within a radius of 100 kms. This plant has secured ISI certification. It has its own in-house laboratory too. Other plant owners get their 'job-work' done in this plant. That is, water and ISI mark are from this plant but the outer printed plastic-sheet-roll is from the other firm that is getting the job-work done. The detail descriptions of the 14 plants are shown in Annexure – 4.1, 4.2, and 4.3.

All these plants use their own brand name for their pouch-product. They all have Trade license with them; some have license as Food and Beverage units from the Health department of the local Municipality. Of the 14 plants, 5 are working on partnership basis and 9 as proprietary units. Of these, 4 out of 14 plants (nearly 29 per cent) were established in 2000 (largest number of establishment during 1996 to 2002), 3 in 1996, 2 each in 1998, 1999 and 2001, and 1 in 2002 (Table-1).

Client base varies from 70 to 1000 and the plants have permanent clientele for the whole year (Table-2). Thus, the total number of customers is 4890, and there are 350 customers on average registered with each plant for a year. 3105 out of the 4890 families buy 10 litres of water per day and 1785 families buy 20 litres per day (Annexure - 4.1, 4.2 and 4.3).

Those who have closed down their plants after the ISI mark became mandatory, have some other source of income. Of course, this investigator has witnessed clandestine production at least in three places. To avoid notice, some of them sell their pouches to shops in the interiors and pouches with ISI mark printed on them to shops on the main road.

Table-2: Client Base and Fees/Rates Scheme of the Plants

Items	Descriptions	No. of Plants	
Client Base	70 – 300 Annual Members in =	9	
	400 – 500 -do- =	2	
	600 – 1000 -do- =	3	
	Total Plants =	14	
Fees/Rates Scheme	Rs 1500 / 10 LPD for a Year in =	9	Some plants have both Types of Rate
	Rs 2500 / 20 LPD for a Year in =	7	
	Rs 90 – 100 / 10 LPD for a Month in =	3	
	Rs 180 – 210 / 20 LPD for a Month in =	4	

Source: Field Data

If 10 LPD costs Rs 1500 a year, then the price of 3650 litres would be Rs 1500 (assuming that the family buys 10 litres everyday). Therefore, the average price of one litre water packed in Jerry-can/PET jar is (1500 ÷ 3650 =) Rs 0.41 or 41 Paise per litre, and (2500 ÷ 7300 =) Rs 0.34 or 34 Paise per litre when a client buys 20 LPD for the whole year. The pouch-packed water in of 250 ml is sold at ex-factory price of 30 paise per pack and consumers get it at MRP Re 1.00. The ex-factory price for a litre (four pouches) would be Rs 1.20. Thus, the smaller the pack, the higher the unit price. At 20 LPD, it would be to 34 paise; at 10 LPD, it would be 41 paise; and at 250 ml, the price of pouch-packed water (MRP) is Rs 1.00 for the consumers.

The business people of Gujarat are very innovative. They have good business acumen. For keeping track of their daily sale to clientele, they have several good systems like keeping record

in cards for every month with date in which client would write down quantity of water delivered by the service-boy (Table-3).

Table-3: Types of Maintaining Records and Modes of Collection by the Plants

Type of Record Keeping For Members	None	=	9
	Cards	=	4
	Coupons	=	1
	Total Plants	=	14
Mode of Fee Collection	Yearly Advance or at the End	=	8
	Monthly	=	5
	Coupon	=	1
	Total Plants	=	14

Source: Field Data

This helps them to make fault-free bill at the end of the month. Some keep daily coupon on which quantity of water delivered is printed. Customers purchase a book of 30 coupon and tears out and pass it on the service-boy according to their purchase every day. Thus the plant owners keep the track of their sales and services. Those who are taking advance payment they do not keep any such daily records for each customer, they issue a receipt of payment to the customer. Nine plants of 14 do not keep any records, 4 of them keep records of supply water to customers in cards, and one issue coupons to customers, so the customers can have the flexibility of their consumption (Table-3).

There is seasonal variation in demand of treated water during the year. The demand reduces in the lean season by 40 per cent of what it would be in the peak season. This variation is generally sensitive to the pouch-packed water and not much sensitive to the domestic consumption. Therefore, permanent clientele remains the same with out much change in their consumption.

Table-4: Pouch Packing and Plant Capacity

Pouch Packing	Closed Down (Temporarily)	=	9
	Continuing Clandestinely	=	3
	Getting Job-work Done	=	1
	Never Done	=	1
	Total Plants	=	14
Plant Capacity	500 Litre Per Hour (LPH)	=	2
	750, 800, 900 LPH	=	3 (one each)
	1000 LPH	=	5
	1200, 1500 LPH	=	2 (one each)
	2000 LPH	=	2
	Total Plants	=	14

Source: Field Data

After the announcement of making ISI certification mandatory, many of these ‘cottage’ plants have been closed down. The owners (nearly 64per cent) closed down the production of pouch-packed water on which the ISI mark has been made compulsory. Three of them are producing pouch-packed water clandestinely and one producing through job-work (Table-4).

The plant capacity are varying from 500 to 2000 Litre Per Hour (LPH). Less than 1000 LPH is not so popular or may not be economical to their scale of production. There are 5 plants (35per cent) have capacity of 1000 LPH and 4 plants (nearly 29per cent) have capacity above 1000 LPH rather up to 2000 LPH among the 14 plants (Table-4).

The Economy of the Plants

The individual economy of these plants may help us get further insight into their activities. We have collected data related to Number of Pouches (250ml) produced/sold per day at ex-factory price of Rs. 0.30 per pouch. We have yearly and monthly fees/rates for 10 and 20 litres per day in Jerry can or in PET bottles, along with number of annual membership. We have calculated the annual gross sale, gross expenditure, and gross profit (Table-5).

The annual gross sale in a year has been calculated as following:
(1) Number of pouch produced/sold multiplied by 30 paise.
(2) Calculated revenue from individual type of membership multiplied by the annual rate. For example, members of 10 LPD multiplied by rates, for instance Rs 1500 etc. Similarly, calculation was made for the 20-litre membership annually by rate of Rs 2500.
(3) Add the sum of (1) and (2) to get gross income shown in Table-5.

For the annual gross expenditure, we have converted all daily or monthly expenditures collected, to annual expenditure. For example, if the rate/fee collected daily, then it is multiplied by 365 days, and if it is collected monthly, then it is multiplied by 12 months. In some cases, when it was found that some expenditure occurred once in three years, like the cost of RO membrane, then we have divided that expenditure by three and then added to the yearly expenditure. We have also taken 12per cent as interest on Plant and Machinery cost and 12 per cent depreciation on the same, and added all this to the gross expenditure. The cost of plant installation includes RO plant machinery, packaging machine and stainless steel storage tanks. Adding all these, we arrived at gross expenditure.

In the following Table-5, we have shown the Investment cost of plant and machinery including pouch packing machine and storage tank, Annual Production of water, Annual Sale amount of Water, Annual Gross Expenditure and Gross Annual Profit, and also Production Expenditure per litre of water of the 14 plants we have visited.

The method of obtaining the total quantity of water sold by each manufacturer is as follows:
a. Sale from Pouch: It is reported that the sale of pouch is very sensitive to season. During the lean period it has been reported to be 40per cent less than that in the peak period. The peak periods are taken to be the months of March, April, May June ie, 120 days. For remaining 240 days, the sale of pouch has been taken as the 60per cent of the sale in the peak period.
b. Annual Sale to 10-litre membership
c. Annual Sale to 20-litre membership

Table-5: Plant and Machinery, Annual Production, Sale, Expenditure, Profit and Per Litre Expenditure of Production of Water

Sl. No.	Towns	Total Plant and Machinery Rs in Lac	Annual Prodn. of Water Lit in Lac	Annual Sale of Water Pouch + Can Rs in Lac	Gross Annual Expenditure Rs in Lac	Gross Annual Profit Rs in Lac	Expd/Prd = Rs per Lit Expd.of Prodn. of Water
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	Kadi	4.25	8.03	3.30	3.85	- 0.55	0.48
2	Mahesana	5.25	43.10	15.00	5.46	9.54	0.13
3	Mahesana	4.25	12.43	7.46	2.93	4.53	0.24
4	Mahesana	3.75	10.95	4.25	2.55	1.70	0.23
5	Mahesana	5.75	13.69	4.95	5.01	- 0.06	0.37
6	Maktupur/Unjha	4.25	22.33	17.64	3.37	14.27	0.15
7	Visnagar	5.25	6.57	2.55	4.47	- 1.92	0.68
8	Sidhpur/Khali	10.75	49.50	59.40	6.25	53.15	0.13
9	Unjha	4.25	30.83	15.84	6.62	9.22	0.21
10	Unjha	8.25	46.75	22.92	11.35	11.57	0.24
11	Patan	7.75	42.40	25.92	5.35	20.57	0.13
12	Patan	5.25	5.84	1.73	1.26	0.47	0.22
13	Patan	6.25	44.93	17.64	5.58	12.06	0.12
14	Chanasma	7.25	16.49	16.92	4.89	12.04	0.30
	Total	82.5	353.82	215.51	68.94	146.57	0.19
	Avg. of 14 Plants	5.89	25.27	15.39	4.92	10.47	0.19

Source: Field Data

Note: A detailed Table has been appended as Annexures – 4.1, 4.2, and 4.3.

The calculation to arrive at gross sale of water in Rupees is shown by way of an example[9]:

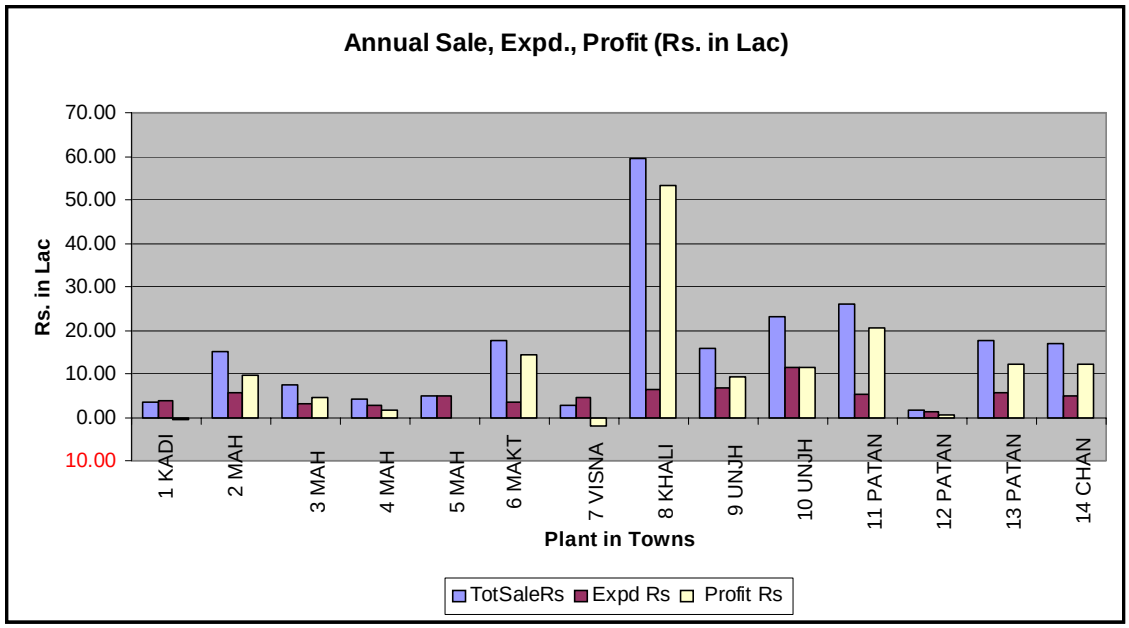
Of the 14 plants under survey, 8 plant owners (57 per cent) when asked, declared about their profit that they have an annual turnover of Rs 3 to 5 lac, and 4 plant owners (28 per cent) of Rs 5 to10 lac. One plant owner has a turnover of less than Rs 3 lac, and one has yet to complete one year of establishment. This information found to be unmatched with their income expenditure data.

[9] Plant No. 9 in the Table – 3 sells 8000 pouches a day at an ex-factory sale price of Rs 0.30. (Annexure – 4/2)

1. Therefore, the sale for the peak period ie 120 days is 8000x0.30x120= Rs 288000.
2. During the lean season the No. of pouches sold per day will be 8000x.60 = Rs 4800.
3. For the lean period, the sale for 240 days will be 4800x0.30x240 = Rs 345600.
4. Total proceed from the sale of pouch during a year thus, Rs 288000+Rs 345600=Rs 633600 or Rs 6.34 lac.
5. The sale proceed from 10-litre membership = 300 x Rs 1500 = Rs 450000.
6. The sale proceed from 20-litre membership = 200x Rs 2500 = Rs 500000.
7. Thus total sale proceed = Rs 633600 + Rs 450000 + Rs 500000 = Rs 1583600 or Rs15.84 lac.

Analyzing the data of income and expenditure we found, that there are 3 plants (21per cent) are running in loss. Three (21 per cent) of the 14 plants have a profit Rs 1 lac to Rs5 lac. Two (14 per cent) have made profit of Rs 6 lac to Rs 10 lac; 4 (28 per cent) have made profit of Rs 11 to 15 lac; and 2 have made profit more than Rs 15 lac, but one of these 2 has made a profit of more than Rs 53 lac. That is, 6 (43 per cent) out of 14 plants in the sample have more than Rs 10 lac gross profit. The highest gross profit (Rs. 53.15 lac) is found in the plant at Khali in Sidhpur Taluka. It is interesting, that though 8 of them declared when asked, that they are in the group of Rs 3 to 5 lac turnover, 6 of them (after analyzing the data) have actually notched up a gross profit of more than Rs 10 lac. Thus, there is plenty of opportunity to make profit in this industry.

The average cost of production per litre of water is found to be 0.19 paise taken 14 plants together (Table-5). The 3 plants which are in loss having very high cost of production per litre of



water, 0.48 paise, 0.37 paise and 0.68 paise; the plant which has lowest cost of production 0.13 paise made the highest profit among all the select plants.

Those who have made profit made it from one to five folds over their plant and machinery investment. Losses are possibly very temporary, as the pouch making has been stopped for the time being due to the ISI issue. For those who have gone out of business at present, this 'packed water' manufacturing is reported to be secondary. The loss that has been shown may be under reported, because many of them say that they have stopped manufacturing pouches. However, this is not so as clandestine production continues at night. It is got done some where else also.

Plant Owners' Opinions and their Activities

1. The TDS of the input/raw water varies from the lowest of 800 ppm to highest of 2000 ppm. Fluoride is found present up to 2.5 mg/litre. The quality of raw water also varies from place to place. The TDS content is very high (1600 to 2000 ppm) in Mahesana city. In other areas like Unjha, Sidhpur, Visnagar, and Patan, the content of TDS varies between 800 and 1000 ppm.

2. The plant owners do not send samples of water for a detailed laboratory testing at regular intervals. It is done once at the start of the plant when test are done both on the raw and the treated water. Although they do not go in for day-to-day testing, they test water at both the input and output levels in the plants using a TDS checking meter. They also check daily the pH etc using a pH kit. The TDS content of the output water ranges from 150 to 300 ppm and Fluoride content is 0.26 to 0.50 mg/litre.

3. It is said that the RO process, while it reduces the TDS in the water up to 90 per cent it also simultaneously reduces Fluoride proportionately in terms of the per cent of TDS reduced. For example, TDS is reduced from 2000 to 200 ppm, ie up to 90 per cent. Therefore, if Fluoride content is 2.5 mg/litre in raw water, then that would also be reduced by 90 per cent of 2.5 ie, 0.25 mg/litre. Dr P S Anand, Senior Scientist of CSMCRSI, Bhavnagar, has confirmed this.

4. In the RO system, 30 to 50 per cent of wastewater is generated while processing the raw water. Supposing that the wastewater is on an average 40 per cent, and it is more when a plant with low capacity is in use. For instance, a 1000 LPH plant will produce less wastewater than the 250 LPH plant. This wastewater can be sent back to the source, and reused for RO system, says Dr (Ms) Joshi of CSMCRI, Bhavnagar. They have been doing it in their laboratory. Businessmen do not care about it and mostly drain it in the gutter. Some use it for cleaning and washing in the factory.

   Environmental Planning Group Ltd. in Ahmedabad has proposed the re-use of wastewater (after converting it in to soft water) for washing, bathing and cleaning purposes in housing complexes to which the same company has offered a Captive RO plant[10]. So there is possibility of re-using the wastewater.

   Otherwise, those who can not buy the treated water are deprived of un-treated water too. If the production of one litre of treated water requires two litres of raw water, then what it means is that either one should give 'bad' water to two persons (taking one litre requirement per person) or 'good' water to one person. This depends on the 'trade off' between the two, and the public policy and plans of the government. Or, an effort should be made to supply 'good' water to two persons.

5. These plant owners have to buy water from private sources at Rs 100 per tanker containing 4000 litres of water even when they do get water from Municipality or Panchayat sources. A litre of tanker water generally, comes to 2.5 paise per litre. At times, particularly in

[10] Captive RO Plant: Environmental Planning Group Limited of Ahmedabad has floated this concept. The plant space will be provided by the housing society, EPGL will design, supply and install the RO plant to supply mineral water daily to each house according to requirement. They will charge 35 to 50 paise per litre and this will be less if customers take self-delivery. The bill of the month will be according to consumption. EPGL would not sell water outside. The one-time deposit (amount depends on plant investment) taken from the members will be given back to the member without interest, when he/she will leave the housing society. There are two such captive plants in Ahmedabad run by EPGL as informed. EPGL also have designed softener plant to supply soft-water to the members of captive plant for bathing, washing and cleaning by re-using the wastewater from RO plant.

summer, or when regular supply of water is not available, plant owners have to spend this extra.

6. According to of the plant owners, regular short time testing of raw water is un-necessary, for they argue that the quality of the raw water does not change often if the supply source remains same. They test for TDS only with handy TDS meters for different sources of supply.

7. With regard to expansion of their plants, most of the plant owners said that they would expand the capacity of their plants if the demand for treated water increases. However, many of them have excess plant capacity and expressed the view that with the ISI mark made mandatory, they may be forced to increase the price of the treated water leading to the possible decline in the demand for treated water. Most of them felt that they do not require in-house laboratory because even if they did not have it their product would not be 'low-quality'. Some believe otherwise. They feel that the assurance and trust of the ISI mark would ensure the creation of a better market for them. Even so, it is true that some of the small operators would be forced to shut down because it would require more investment. They may expect some subsidy from the government, and government could think of subsidizing the industry in public interest. Thus, again the suppliers or market players would be smaller and as a result of this, opportunities would be created for strong players only.

Coming back to the 14 plants surveyed, we know that these plants cater to only 4890 families. If we take the average family size to be 5, then these plants would supply 'good' water (better than the water supplied by the municipality water) to 4890 x 5 = 24,450 persons approximately.

Table-6: Population Buying Packed Drinking Water in Mahesana and Patan from the Selected Plants

Sl. No.	Taluka		Population Census 2002	Families Buying Packed Water	Population Buying Packed Water * Approx.	per cent of Population
(1)	(2)		(3)	(4)	(4) x 5	(5) = (4) / (3) *100
1	**Unjha**	**T**	174255	1475	7375	4.23
2	**Maheasna**	**U**	148103	1750	8750	5.91
3	**Visnagar**	**U**	73490	150	750	1.02
4	**Kadi**	**U**	60027	220	1100	1.83
5	**Sidhpur**	**R**	132720	100	500	0.38
6	**Patan**	**U**	113568	1125	5625	4.95
7	**Chanasma**	**U**	15819	70	350	2.21
	TOTAL		**717982**	**4890**	**24450**	**3.41**

Source: Column (3) Census 2001 Provisional, Mahesana and Patan District Office. (4) Field Data.
* Selected Members/Families Buying Packed Water x 5 = Population Buying Packed Water Approximate Estimate, taking 5 as a family size. T = Rural + Urban; U = Urban; R = Rural

We have considered the urban and rural population according to the location of the plants and their area of distribution. If a plant were in the urban or the rural areas, then the comparison would with the respective population only. The individual consumers would be the numbers of families buying mineral/treated water multiplied by 5. Thus, it can be seen that these plants would cater only to 3.41 per cent of the total population of the area where plants are situated. The highest number is in the urban areas of Mahesana and the lowest is in the rural areas of Sidhpur. The buyers of water packed in pouches have not been considered in the estimates (Table-6).

Consumer Scenario

We shall move on to a discussion on the consumers benefiting from this industry. We have interviewed 60 consumers' families who form the clientele of the 14 plants as shown above because they live in the same city/town where the plants are situated. The clientele/families of different companies are shown in Table-7.

Table-7: Distribution of Clients among the Companies

Sr. No.	Place	Brand Name	Name of the Company	No. of Clients
1	Kadi	Amruta	Amruta Mineral Water	6
2	Mahesana	Enjoy	New Uma Beverages	9
3	Mahesana	Radhe	Uma Beverages	9
4	Mahesana	Royal	Suraj Beverages	6
5	Visnagar	Akshar	Shreeji Aqua Service	5
6	Unjha	Jay	Jay Water Treatment	6
7	Unjha/ Bramhanwada	Hit	Hit Mineral Water	4
8	Unjha	Megha	Megha Mineral Water	5
9	Patan	Raj	New Laxmi Mineral Water	2
10	Patan	Joy	Joy Minerals	6
11	Sidhpur	Challenge	N K Industries	2
	Total			60

Source: Field Data

Three of the plants, 1 each in Mahesana, Patan and Chanasma have not been presented here for various reasons like:

(1) we could not get any customer of Nirmal Mineral Water in Mahesana, and
(2) Geeta Water Plant in Patan, and Sai Mineral Industries in Chanasma, have a small clientele base of 125 and 70 respectively.

These 60 families together have 300 members, with 5 members per family on an average (Table-8). Among the 60 respondents, 53 are males and 7 are females. The average age of male respondents is 43 years and that of female ones is 35 years. 22 of these are businessmen, 4 self-employed, 22 belong to the service sector, 6 doctors, 3 housewives, 2 farmers and 1 student. 40 respondents are postgraduates, of which 27 belong to arts or science, 13 to engineering, 18 educated up to SSC/HSC, and only 2 have not completed schooling (non-SSC) (Table-8).

We found quality consumers - educated people and professionals well placed in society in all these places. This is the reason why they are conscious about mineral or packed treated water. Among the consumers, not all were very co-operative in volunteering information required. Even so, they were all co-operative in providing information about their experience with packed drinking mineral water.

Members of the three cities - Kadi, Mahesana and Unjha - pay their bills in advance annually. The rates are Rs 1500 for 10-litre and Rs 2500 for 20-litre if water is bought every day throughout the year. In other places, like Patan, Visnagar and Sidhpur, they pay at the end of the month. The supplying plants follow Card system, with the delivery boys taking the signature of the members after delivering the required quota of water in can/bottle everyday. Then at the end of the month, they have to pay for the number of cans and bottles they have consumed. This system is followed very professionally and the customers are flexible in terms of the consumption of water according to their needs.

Table-8: The Distribution of Sixty Respondents by their Age, Sex, Occupation and Education

City >	Kadi	Mah	Vis	Unj	Pat	Sid	Bam	Tot
No of Families	6	24	5	13	8	2	2	60
Family Members	28	109	22	79	41	15	6	300
Male	5	21	3	13	8	2	1	53
Female	1	3	2	-	-	-	1	7
Avg. Age Male	34	42	50	47	47	30	50	43
Avg. Age Female	30	32	38	-	-	-	40	35
Business	2	5	2	8	3	1	1	22
Service	-	14	1	4	1	1	1	22
Medicos	1	-	-	1	4	-	-	6
Housewives	1	1	1	-	-	-	-	3
Farmer	1	-	1	-	-	-	-	2
Self-employed	-	4	-	-	-	-	-	4
Student	1	-	-	-	-	-	-	1
Non-SSC	-	1	1	-	-	-	-	2
SSC-HSC	1	9	-	5	2	-	1	18
Graduate	3	9	4	6	2	2	1	27
Post Graduate	2	5	-	2	4	-	-	13

Source: Field Data

Thirty-five families started taking mineral water “just like that” but 12 started on their doctor’s advice, and 13 started on their friends’ advice (Table-9). Fifty felt that the taste of the water was good. All of them, except two, who felt the vendor’s service was poor, thought that the current brand was good. While among the remaining 58, 51 felt that the services of the vendor were ‘good’ and 7 reported the services to be ‘satisfactory’. There are 52 families, who have been taking packed mineral water for more than two years.

On the question of ISI mark, 46 or 77 per cent families said that the mark should be made compulsory but 36 or 60 per cent were not sure whether merely doing so would guarantee quality. However, 46 families were hopeful of getting better quality water after the introduction of ISI mark.

Eighteen families thought that there was improvement in and even recovery at times in case of fluorosis affliction if they took the treated fluoride-free water with recommended amount of fluoride. Fifty-one families asserted that they would take this water for health reasons, and 7 said they would do so for taste if only because the municipality water was bad in taste. There are persons who reported that they got relief from the ailments like constipation and urinary tract infection etc after consuming RO treated water.

Table-9: Consumers Opinion about Mineral Water

City >	Kadi	Mah	Vis	Unj	Pat	Sid	Bam	Tot
Use min. water								
following: Doctor	2	-	1	2	5	1	1	12
Friends	1	9	2	1	-	-	-	13
Just Like That	3	15	2	10	3	1	1	35
Taste of m water:								
Good	5	16	4	13	8	2	2	50
Satisfactory	1	8	1	-	-	-	-	10
Poor	-	-	-	-	-	-	-	-
Brand mw Better:								
Current	6	24	5	13	8	2	2	60
Earlier	-	-	-	-	-	-	-	-
Ranking Vendor								
Service: Good	5	18	5	13	6	2	2	51
Satisfactory	1	6	-	-	-	-	-	7
Poor	-	-	-	-	2	-	-	2
Using min water:								
< 6 months	-	1	-	-	-	-	1	2
6-12 months	1	-	4	-	-	1	-	6
1-2 year	5	12	1	2	-	-	-	20
> 2 years	-	11	-	11	8	1	1	32
ISI Compulsory:								
Yes	6	20	4	6	6	2	2	46
No	-	4	1	7	2	-	-	14
ISI Guarantee								
Quality: Yes	4	12	1	2	1	2	-	22
No	2	12	4	11	7	-	2	38
Fluorosis								
Recovered: Yes	2	6	-	2	7	1	-	18
No	4	18	5	11	1	1	2	42
Drinking mw for:								
Health	5	18	4	12	8	2	2	51
Taste	1	5	-	1	-	-	-	7
Status	-	1	1	-	-	-	-	2
Mntly Income Rs <								
5 Thousand	-	2	-	2	-	-	-	4
5-10 Thousand	-	9	3	2	-	-	1	15
10-15 Thousand	1	9	2	3	1	2	-	18
15-20 Thousand	4	4	-	3	4	-	1	16
>20 Thousand	1	-	-	3	3	-	-	7

Source: Field Data

Among 60 families, 5 (7 per cent) had an income of less than Rs 5,000 per month. Fifteen (25 per cent) fall in the income group of Rs 5,000 to Rs 10,000 per month. Eighteen (30 per cent) were in the income group of Rs 10,000 to Rs 15,000 per month. Sixteen (27 per cent) were in the income group of Rs 15,000 to Rs 20,000 per month. Seven (11 per cent) were had an income of more than Rs 20,000 per month. This gives a clear picture about the consumers' income status. Most of the mineral water buyers (49 of 60 families or 82 per cent) were from the income bracket of above Rs 5,000 to Rs 20,000 per month; more precisely, 34 of 60 families or 57 per cent were from Rs 10,000 to Rs 20,000. Thus high-income groups buy mineral/packed drinking water for good health and others only when they are forced to buy it (Table-9).

To Conclude

The market for the mineral/packed water produced by 'cottage' type industries has developed very rapidly in Gujarat between 1996 and 2000, especially in North Gujarat. From the Jerry can and PET bottle packing, it came down to pouch packing in a very short time. The water packed pouches has more margins as compared to big-packs of 10 or 20 litres. The price of 10-litre packaged water for the year-round customers is Rs 1500, or Rs 4.11 per can. Similarly the price of 20 LPD for the year-round customers is Rs 2500 or Rs 6.85 per can. One pouch of 250ml has the ex-factory price of Rs 0.30 and MRP is Rs 1.00. It sells in number of pouches. Thus the sale of pouches contributes to a large profit even at ex-factory price. Producing packed water in pouches requires only an investment in packaging machine, which the investors find affordable investors as it costs approximately Rs 1 lac. The packed water in pouches has a large market catering to the people at large as it has 'any time, any place' type of market spread.

As long as the municipality's supply of ground water in North Gujarat is high on TDS and has more than recommended amount of fluoride, packed drinking water has a good market. People will spend for good water for the sake of health and often to avoid doctor's fee. So the market will always be there. The only thing that remains to be seen is the shape and size of the market in future.

Small industries of this type can provide Jerry can service at their customers' door within in a radius of six to seven kilometers on demand, through a self-organised distributing system. Suppliers can send pouches to a long distance of twenty kilometers even up to 100 kilometres (as in the case of NK Industries of Khali at Sidhpur, who supply their pouches up to Ambaji). Since pouch works on a simple 'use and throw' system, there is no need for cleaning, washing and replacing of pouches as in the case of cans and bottles.

Permanent customers, who bring permanent revenue to the vendors, require 'customer care' for the whole year whereas those using pouches do not require regular care, except in terms of the maintenance of pouch quality.

Since the yearlong customers are from high-income group and are both health and quality conscious, the manufacturers will definitely have their market, provided they can improve their product and services. For example, suppliers do not use any sealing for Jerry can cap at present. They only seal PET bottle caps. Some ladies residing on the residential area of the ONGC

Campus complained about this lacuna but they have accepted it because there was 'no other' good alternative.

Here comes the ISI issue. For more than a year now, a debate has been going on about the pros and cons of making the ISI mark compulsory for packed drinking water. Since Jerry cans are not sealed, they do not come under the purview of ISI standard specification. Nevertheless, sealed PET bottles do. Thus the use of PET bottles necessitates an increase in the price which, if shared by the consumer, will not pose any problem for the manufacturers who have the ISI certification. Many people are spending extra for the sealed packed water or chilled insulated plastic can etc. In Vallabh Vidyanagar, a manufacturer sells chilled insulated can of 20-litre at Rs 350 per month on home delivery. In Ahmedabad, people buy sealed 20-litre pet jar of Parle's Bailly at Rs 45 for what this means is that people are willing to pay for quality product.

Seeing this changing pattern in the demand and the need for ISI certification, at least 2 of the select plant owners we interviewed are preparing to get the ISI certification. They have understood that they must follow certain norms in the changing scenario if they like to continue in this market. The manufacturers also expressed their view that they would definitely increase their plant capacity if the demand were to increase, and this is bound to happen. So the growth of this industry is assured.

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Annexures

Annexure - 1

Structured Questions II: for the RO Plants Owners

Fluoride-Free Drinking Water Supply in North Gujarat:
The Rise of RO Plants as a Cottage Industry

An Exploratory Study

Sponsored by International Water Management Institute [IWMI]

Name of the Interviewer: Date:

1. Plant's Identification

1.0	Name of the Company:				
1.1	Name of the Product:	1.2	Represented by: Mr/Mrs		
1.2	House Name/House No.:	1.3	Street:		
1.4	Area/Locale:	1.5	City:		
1.6	Taluka:	1.7	Distt: Mahesana (Mahesana + Patan)		
1.8	State: Gujarat	1.9	PIN Code		
1.10	Telephone: Area Code:	1.11	No.:		
1.12	E-mail:	1.15	Mobile No.:		
1.16	Nature of the Company	Proprietary	Partnership	Pvt Ltd	Ltd
1.17	Year of Establishment:	License No. (if any)			

2. Customer Base

2.0	No. of customers you cater to:	<500	500-800	800-1000	>1000
2.1	No. of permanent members of the above	<500	500-800	800-1000	>1000
2.2	Method of keeping records of supplies to the customers			Cards/ Logbooks/ None	
2.3	Fees you collect for the supply of 10 /20 Litres Per Day (LPD)	Daily	Rs /Mtly	Rs /Hly	Rs /Yrly
2.4	No. of members purchasing 10 litres per day			Numbers:	
2.5	No. of members purchasing 20 litres per day			Numbers:	
2.6	Mode of collecting fee:	Daily	Monthly	Qtly	Hly / Yly

3. Production

3.0	No. of pouches of 150/200/300 ml you produce per day	No.
3.1	Quantity produced in pouch per day	Litres:
3.2	The MRP for the pouch	Rs
3.3	The total quantity (Pouch + Jerry Can) you sell per day	Litres:

4. Plant Capacity

4.0	The capacity of the plant: litres per hour (LPH): Actual	Litres:	
4.1	The total production: litres per day (LPD) Actual	Litres:	
4.2	Seasonal variation, if any, in production	Yes	No
	If, 'yes', what is the difference? in per cent + or -	per cent	per cent

4.3	The cost of initial establishment of the plant only				Rs			
4.4	The area in your plant in square feet				sq.ft			
4.5	The area required for a plant capacity like yours:				sq.ft			
4.6	This space is	Owned	Leased	Rs	Rented	Rs		/Mth
4.7	Company from which you have purchased the plant				Name:			

5. Operating cost

5.0	Electricity charges? Annual or Bi-monthly?	Rs.	
5.1	Materials needed for the plant: a) Salt b) Chemicals c) Resin d) RO Membrane When was it last replaced? Make and size of membrane:	Rs. Rs Rs Rs	/Month /Month /Month /Year
5.2	Other maintenance costs (please specify)	Rs	

6. Wages

6.1	No. of persons working in your plant	No.
6.2	The wages you pay per month/per year	Rs.
6.3	Others (please specify)	Rs.

7. Distribution costs

7.0	Do you own any vehicle(s) for distribution?		Yes	No
7.1	If 'yes', then the number of vehicles	No.	Details:	
7.2	Give the amount you spend on diesel/petrol per day		Rs	
7.3	If 'no', then how many vehicles do you hire per day?		Numbers:	
7.4	The cost for hiring vehicles every day/month		Rs	

8. Others

8.0	Do you fall in the of total annual turnover: Rs (Lac)		<3	3-5	5-10	>10		
8.1	The amount of TDS, Fluoride, Chloride etc the raw water contains (Report may be enclosed, if available)							
8.2	The quality of the treated water TDS, Fluoride etc (Report may be enclosed, if available)							
8.3	The quantity of wastewater generated in making 1000 litres of pure/mineral water		Wastewater /1000 Litres:					
8.4	The use/disposal of wastewater	For cleaning	Just throwing		Others			
8.5	In spite of the Prevention of Food Adulteration Act, do you think the ISI mark must be made compulsory?		Yes		No			
8.6	If 'yes', do you think it will increase your sales?		Yes		No			
8.7	What is the period of Raw water test?		Daily	Mtly	Hly	Yrly		
8.8	What is the period of Treated water test?		Daily	Mtly	Hly	Yrly		
8.9	In the absence of Municipality water, do you buy water from outside?		Yes		No			
8.10	If 'yes', what is the price you pay?		Litres:		Rs.			
8.11	When Raw water quality changes what do you do?		Comment:					
8.12	Your opinion about the survival and growth of this industry/if sales increases would you increase your plant capacity?		Comment:					

Signature of the Interviewer

Annexure – 2

Structured Questions I: for the Users/Consumers of RO Treated Water

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Name of the Interviewer: Date:
Respondent's Identification

1.0	Name of the User: Mr/Ms/Mrs/Dr							
1.1	House Name/House No.:			1.2	Hsg. Society/Apts:			
1.3	Street:			1.4	Area/Locale:			
1.5	City/Taluka:			1.6	Distt: Mahesana (Mahesana + Patan)			
1.7	State: Gujarat			1.8	PIN Code:			
1.9	Phone: Area Code:		No.	1.10	Age: in years:			
1.11	Occupation:	Service	SeEmpProf	1.12	Education:	Non SSC	SSC-HSC	
	Medico	Business	Other(speci)		UG-PG General	UG-PG Profl	**SEC**	
1.13	Number of Family Members:							

2. Product Profile

2.0	Product/Brand Name of the Mineral Water:					
2.1	Name (if you know) of the Manufacturer					
2.2	Price of the Mineral Water (per 10/per 20 litre etc.)			Rs		
2.3	Mode of Payment:	Daily		Mthly	Qrtly	Yrly
2.4	Seasonal changes found in the price, if any			Yes		No
2.5	If 'yes', do tell us about the changes:	High		Low		Not Much

3. Usership and Awareness

3.0	Did you start drinking mineral water following advice/suggestion of?	Doctor		Friends or Relatives		Or, Just like that
3.1	How do you like the taste of the water?	Good		Satisfactory		Poor
3.2	Have you tried any other mineral water than the present one?			Yes		No
3.3	If 'yes', do you find any differences between the two?			Yes		No
3.4	If 'yes', which brand is better?	Current	Earlier	Name of Earlier Brand:		
3.5	How do you rank the service of your vendor?			Good	Satisfactory	Poor
3.6	Since how long have you been using mineral water?			<6 m	6-12m	1-2yr	>2 yr
3.7	Have you continued using the same brand?			Yes		No
3.8	If 'no', what were the reasons for changing the brand?					
	Poor Quality	Poor Service	High Bill	Better Taste	Any other	

4.Others

4.0	In spite of the Prevention of Food Adulteration Act, do you think ISI mark must be made compulsory?		Yes	No
4.1	If, 'yes', do you think that will guarantee quality?		Yes	No
4.2	It is said that fluoride is present in the water of this area. Do you know anybody who was suffering from fluorosis, but recovered after using this mineral water?		Yes	No
4.3	The right mineral water is available from springs and this mineral water is actually de-mineralised water. Is the taste good?		Yes	No
4.5	If no, the reason why you use it	Health	Taste	Status
4.6	For making one litre of mineral water using Reverse Osmosis Method (RO), it requires 2 litres of raw water. What do you suggest for this wastewater?		Suggestions:	
4.7	This wastewater contains a large number of bacteria and TDS if it is thrown into a nearby pond from where the same can seep into a well used by many others. Do you think it is harmful for them?		Yes	No
4.8	Kindly state the income group that reflects the best of your monthly income.		Below Rs.5 thousand Rs.5 to 10 thousand Rs.10 to 15 thousand Rs.15 to 20 thousand Above Rs.20 thousand	

Signature of the Interviewer

Annexure – 3

Gujarat Government in Large Scale Fluoride-Free Establishments

Some cases cited here in brief, like that in Ismailpur in Patan, Methan in Sidhpur, where public system of de-fluoridation plant and plant to supply 'good' water were installed but failed to continue after one or two years. The failure mainly due to operational difficulties and management failure, or funding or simply the people are apathetic to understand the severity of the fluoride-caused diseases.

In **Ismailpur**, it was a twin-village project between Ismailpur and Sojintra in Chanasma taluka in Patan division of the undivided Mahesana district. It was not a RO plant, but a plant of de-fluoridation of Nalgonda design installed by GWSSB. There was another also at Jakhana village in taluka. The Ismailpur plant had a capacity of 100 M^3/day (1,00,000 litres/day approx.), and Jakhana, 60 M^3/day (60,000 litres/day approx.). Both the plants were installed in 1999. The cost of construction was nearly Rs 9.34 lac for the Ismailpur plant and nearly Rs 5.21 lac for that of Jakhana. We could not visit Jakhana village.

The maintenance cost for the Ismailpur-Sojintra joint plant, worked out on the basis of the average maintenance over a period of three years, was Rs 3,10,000 per year for a population of 2,805 (according to 1991 Census) in two the villages put together. Thus, it is nearly Rs 110 per person per year, which means 0.30 paise per person per day. Unfortunately, this plant has remained closed for the last one year. The Sarpanch of Ismailpur told this investigator that people were not interested in spending on water. This investigator feels, it may not be so, people do not know all the facts about fluorosis, even though they are suffering from the same. The Deputy Executive Engineer of GWSSB, (which is under Department of Health in Government of Gujarat) said that the project initially maintained by the Government was to be handed over to the village authority after installation. The Government can not continue to bear the burden of maintenance forever. Moreover, the beneficiaries should also share the cost. The Sarpanch's argument was that the government should continue to finance it. When the negligible expenditure for fluoride free water was brought to his notice, he just laughed at the investigator and invited him home for a cup of tea. Investigator came back with the images of so many faces of helpless people afflicted with fluorosis in these two villages. In Chanasma taluka, 70per cent people are suffering from fluorosis! Most interestingly, Ismailpur has a very big newly constructed school and a Marriage Hall of latest design in granite finished stone, just at the entrance of the village. It was difficult to understand people's response to fluorosis. May be, it was sheer callousness of the people towards health.

One more aspect needs to be brought into focus: the effectiveness of a Nalgonda plant, which runs on Alum-based resin. Opinions are divided on its effectiveness. If it were effective, then the cases of musculo-skeletal disease would have been reduced. We agree that if the damage is severe due to fluorosis, then it is irreversible. However, if the damage is not so severe then changing the quality of water should relieve it.

Take the case of **Methan** village in Sidhpur taluka, which is 17 kms away from Sidhpur City. Methan has a Nalgonda kind of De-Fluoridation plant with a capacity of 30,000 litres per day.

This is one of the first plants of its kind established in 1997. It runs on the same Nalgonda technology using Alum-based resin. For the last seven months, it has remained closed. The people of the village are awaiting water from Dharoi reservoir, which has already come up to Kakoshi village – seven kilometres from Methan. Enthusiastic as they are, they have forgone the use of treated water from the plant.

The village has an Aga Khan Health Service (AKHS) Centre because AKHS has adopted the village for its health services. It is as populated by people who are Ismaili Bohras and Hindu families. Ismailis are less than the population of the Hindus, and even so, they live amicably and take part in each other's social activities. They also share good and bad times together.

This village is a target village, that is all the health services of AKHS are made available to the entire population both Ismailis and non-Ismailis. Here by "target" service is meant that the services are rendered in their homes and people can also come to the centre to avail of the health services. So they have treated all the population of the village as 'target' population – all this because AKHS has adopted the village for providing health services.

The village has people suffering from many types of water borne diseases like typhoid, cholera, gastro-intestinal disorders, hepatitis/jaundice, dental problems, malaria, musculo-skeletal diseases (fluorosis/gout etc). The numbers of cases as found in the MIS reports of AKHS Centre in the village are shown in Table-A.

In some villages, AKHS has only a service centre and AKHS offers services only from the centre and do not go to the peoples' door. People go to the centre whenever they need AKHS's Health Service. The AKHS have 9 such centres in Sidhpur Taluka.

Table-A: Reports of Morbidity of October to December, 2001 for Target People of AKHS Centre of Methan

Diseases		Male	Female
1. Diarrhoea / dysentery	I	3	3
	NI	8	12
2. Typhoid / Cholera	I	1	1
	NI	2	1
3. Gastro Intestinal Disorders	I	15	8
	NI	13	12
4. Hepatitis / Jaundice	I	0	0
	NI	0	0
5. Dental Problem	I	2	3
	NI	2	6
6. Malaria	I	2	3
	NI	5	6
7. Musculoskeletal Disease	I	108	108
(Fluorosis/Gout etc.)	NI	48	82

Source: MIS Report of the AKHS Centre, Methan
I = Ismailis and NI = Non-Ismailis

It has a population of 3,200 on record but many of them have migrated from here from here. So actual terms, the population is only 2600 strong now. The new Sarpanch, Shri Mohanbhai

Prajapati got selected through '*Samras*' scheme in panchayat elections this year. Under '*Samras*' scheme, a village avoids election and instead selects their people as representatives. Following the '*Samras*' scheme, a village can get an amount of money from the government on basis of the population of the village. The Methan Panchayat got a grant of Rs.60,000 instead of Rs. 1 lac as the village has less then 5000 people. They are yet to receive the amount. Shri Mohanbhai Prajapati took office on 1 May 2002 at Methan Gram Pranchayat.

The Ismailis or Khojas are Muslims who subscribe to the Aga Khan Philosophy. Among Hindus they are more of OBCs, than there are people from the higher castes. However, both the communities live together in harmony.

A de-fluoridation plant was set up in this village in 1997 at a cost of Rs. 1,05,000 plus other cost of Rs.25,000 taking its total cost to Rs. 1.30 lacs. The capacity was 30,000 litres. The operating cost was Rs.3,000 per month including a salary of Rs.2000 per month paid to the operator and Rs.1000 per month for chemicals like resin, alum etc. 20 litres of water a day was sold to people of the village at Rs.30/- per month and 10 litres a day at Rs.15/- per month. They had to carry water from the plant by themselves.

There were 244 members buying water from the plant. Of these 244 members, 150 used to buy 10 litres a day and 94 bought 20 litres a day. These 150 members are from a total of 285 Ismaili families of the village. The income work out to Rs. 5820, which was sufficient to cover the operating cost leaving some savings if the fees were received regularly. The plant was a Resin-stone layer filtration plant washed by Alum-solution from time to time. The operator used to mix a fixed dose of Alum-solution of 100 litres for 30000 litres of water. The resin was also recharged from time to time. This plant was made by Indian Ion Exchange Bombay and was managed by Muniavarbhai Chunilalbhai Trust.

The plant has remained closed for the last 7 months in the expectation of water supplies from Dhorai Dam. This has not happened to date. The decision of closing down the plant was taken by the ex-Sarpanch Mr. Amir Ali. The new Sarpanch, selected under Samras scheme of Gujarat Government approves of the decision of closing down the plant in anticipation of receiving water from Dharoi Dam. The water from the Dharoi Dam supplied to Sidhpur is mixed with ground water, which is 17 kms. away. The pipeline has reached up to Kakoshi village which is about seven kms. away from Methan. So the people of Methan are very optimistic.

According to Smt. Hansaben, the nurse at AKHS centre of Methan, who has been working there for the last twelve years, Hindus find it less affordable to use this treated water. "There are people among Hindus who take only black tea for their dinner" and "they survive with the support of their neighbours" said Hansaben. Invisible poverty is too high in this village.

The Report of AKHS shows that more of Ismailis suffer from Musculo Skeletal Diseases (MSD), which includes fluorosis, gout etc. Hence, they use more de-fluoridated water than others. During Oct.- Dec., 2001, MSD patients in AKHS centre of Methan consisted of 108 M + 108 F among Ismailis and 48 M + 82 F among Non Ismailis (see Table-1 above). Only younger people suffering from fluorosis in its initial stage take de-fluoridated water. Even this group has been deprived of de-fluoridated water for the last seven months. Some of the victims are beyond

recovery and do not benefit from the supply of de-fluoridated water. This may be one of the reasons why they are less interested in continuing to run the plant. There are many pathetic cases of fluorosis here.

Experiments conducted to study in depth the Nalgonda Technique of De-fluoridation of water thoroughly with the objective of implementing practically the technique in fluorosis–affected villages around Gandhigram have thrown up results that prove this technique to be erroneous one as has already stated earlier. Doubts persist that 100 litres of alum-solution is not sufficient to de-fluoridate 30,000 litres of water. The tank system is not sufficient enough. The operator, Shri Saiyad, opined that as against raw water fluoride of 1.7 mg/litre, the treated water fluoride is 0.6 mg/litre. Shri Saiyad also told us that more of Ismailis use this de-fluoridated water than the Hindus. All these factors seem to have contributed to people's lack of interest in using water from the plants.

Bramhanwada, a village, has nearly 60per cent of its population suffering from fluorosis, and these people feel better after using mineral/treated water and some have got cured after using the treated water. However, the people of Methan could not get cured. In Methan, possibly, the ineffective working of the Nalgonda method of de-fluoridation owes itself to an erroneous mechanism as told above. People believe that if the water is changed, there are chances of reversing the process. They practised it on their own, and some people this investigator met, have been cured absolutely of their fluorosis affliction though the marks remain intact. In other words, it is clear that if the damage due to fluorosis were not severe then there would be a possibility of reversing the process. This village on the highway between Unjha and Sidhpur, provides an example of how this is so.

Dharmoda village in Chanasma taluka has two tubewells and a tank with the capacity of 5,00,000 litres potable water supplied to 12 villages. Each tubewell is 510 feet deep. Water from these is supplied after making it more palatable by mixing chlorine salt. The water is supplied 4 hours a day. We took a sample of water of this well and found no salty taste. The distance of the farthest village is 28 kms from the source of this tubewell. They say that there is no fluoride in the water of these tubewells. There are 6 tubewells of this kind every 15 kms in a line in Dharmoda, Lanwala, Pinpal, Modhera. Dharmora's 2 tubewells cover 12 villages. They have already set up a water filter/treatment plant, which will be used when the Narmada Water reaches there. A chlorine gas unit has also been set up for making chlorine solvent so as to make water potable at the outlet for supply to this village. 10 litres of Chlorine salt is used per 5,00,000 litres of water.

With an approximate population of 25,000, these 12 villages get their drinking water supply from these tubewells and the same water is available for their animals.

Interestingly, 5 of these 12 villages (Bramhanwada, Samisha, Chapwada, Suraj and Adiwada) do not use the water from these tubewells. People of these villages have their own private tubewells, where the water has more TDS according to Works Assistant, GWSSB, Dharmoda, Chanasma. Again a failure of the government sector! Thus, market for the production of de-fluorinated with less TDS by 'cottage' RO plants came into existence.

Annexure – 4.1

PLANT CAPACITY in DETAIL

Sl. No.	*Description*	*Plant*	*Plant*	*Plant*	*Plant*	*Plant*
	Identification					
1	Place	**Kadi 01**	**Mahesana 02**	**Mahesana 03**	**Mahesana 04**	**Mahesana 05**
2	Name of the Company	Amivarsha Beverages	New Uma Beverages	Uma Beverages	Suraj Beverages	Nirmal Mineral Water
3	Brand Name	AMRUTA	ENJOY	RADHE	ROYAL	SOHUM
4	Nature of the Company	Partnership	Partnership	Proprietary	Proprietary	Proprietary
5	Year of Establishment	Nov., 2002	1998	1996	2000	June, 2000
6	Owns License	Yes	Yes	Yes	Yes	NO
	Client Base, Fee, Collection					
7	Client Base	200	1000	200	250	300
8	Fees/Rates Annual Rs for 10-Litre	1500	1500	1500	1500	1400
9	Fees/Rates Annual Rs for 20-Litre	N A	N A	2500	2500	2400
10	Type of Record Keeping for Members	None	None	None	None	None
11	Mode of Fee Collection	Annual	Annual Advance	Annual Advance	Annual Advance	Annual Advance
12	Pouch Packing	Currently Stopped	10,000 per Day	5,000 per Day	Currently Stopped	NO
	Plant Capacity					
13	Plant Capacity Litres Per Hour (LPH)	500	2000	1000	1000	1200
14	Cost of Plant/Machinery in Lac Rs	4.25	5.25	4.25	3.75	5.75
15	Plant Area Sq Ft	900	1500	1200	2500	960
	Annual Sales, Expd, Profit					
16	Total Annual Sale in Lac Rs	3.3	15.00	7.46	4.25	4.95
17	Total Annual Expenditure in Lac Rs	3.85	5.46	2.93	2.55	5.01
18	Total Annual Profit in Lac Rs	-0.55	9.54	4.53	1.7	-0.06

Source: Field Data

Annexure – 4.2

PLANT CAPACITY in DETAIL (Contd.)

Sl. No.	*Description*	*Plant*	*Plant*	*Plant*	*Plant*	*Plant*
	Identification					
1	Place	**Maktupur/ Unjha 06**	**Visnagar 07**	**Khali/Sidhpur 08**	**Unjha 09**	**Unjha 10**
2	Name of the Company	HIT Mineral Water	Shreeji Aqua Services	N K Beverages	Jay Water Treatment	Megha Mineral Water
3	Brand Name	HIT	AKSHAR	CHALLENGE	JAY	MEGHA
4	Nature of the Company	Proprietary	Proprietary	Proprietary	Partnership	Proprietary
5	Year of Establishment	July, 1998	2001	August, 2000	1999	1996
6	Owns License	Yes	Yes	Yes / ISI Certification	Yes	Yes
	Client Base, Fee, Collection					
7	Client Base	175	150	100	500	800
8	Fees/Rates Annual Rs for 10-Litre	1500	1500	N A	1500	1500
9	Fees/Rates Annual Rs for 20-Litre	2500	2500	2400	2500	2500
10	Type of Record Keeping for Members	None	Cards	None	None	None
11	Mode of Fee Collection	Annual Advance	Annual / Monthly	Monthly	Annual / Advance	Annual / Advance
12	Pouch Packing	20,000 per Day	Currently Stopped	75,000	8,000	10,000
	Plant Capacity					
13	Plant Capacity Litres Per Hour (LPH)	750	500	1500	900	2000
14	Cost of Plant/Machinery in Lac Rs	4.25	5.25	10.75 (icluding Lab)	4.25	8.25
15	Plant Area Sq Ft	900	600	3500	1500	900
	Annual Sales, Expd, Profit					
16	Total Annual Sale in Lac Rs	17.64	2.55	59.4	15.84	22.92
17	Total Annual Expenditure in Lac Rs	3.37	4.47	6.25	6.62	11.35
18	Total Annual Profit in Lac Rs	14.27	-1.92	53.15	9.22	11.57

Source: Field Data

Annexure – 4.3

PLANT CAPACITY in DETAIL (Contd.)

Sl. No.	***Description***	***Plant***	***Plant***	***Plant***	***Plant***
	Identification				
1	Place	**Patan 11**	**Patan 12**	**Patan 13**	**Chanasma 14**
2	Name of the Company	Dev Bhumi M W Plant	Geeta Water Plant	Joy Minerals	Sai Mineral Industries
3	Brand Name	RAJ	GEETA	JOY	VARSHA
4	Nature of the Company	Proprietary	Partnership	Proprietary	Partnership
5	Year of Establishment	1999	April, 2002	1996	2001
6	Owns License	Yes	Yes	Yes	Yes
	Client Base, Fee, Collection				
7	Client Base	400	125	600	70
8	Fees/Rates Annual Rs for 10-Litre	N A	90	N A	100
9	Fees/Rates Annual Rs for 20-Litre	210	180	180	200
10	Type of Record Keeping for Members	Cards	Cards	Cards	Coupons
11	Mode of Fee Collection	Monthly	Monthly	Monthly	Monthly
12	Pouch Packing	20,000	N A	10,000	20,000
	Plant Capacity				
13	Plant Capacity Litres Per Hour (LPH)	800	1000	1000	1000
14	Cost of Plant/Machinery in Lac Rs	7.75	5.25	6.25	7.25
15	Plant Area Sq Ft	900	720	2500	5000/Soft Drink Plant
	Annual Sales, Expd, Profit				
16	Total Annual Sale in Lac Rs	25.92	1.73	17.64	16.92
17	Total Annual Expenditure in Lac Rs	5.35	1.26	5.58	4.89
18	Total Annual Profit in Lac Rs	20.57	0.47	12.06	12.04

Source: Field Data