Dept. of Public Health Dentistry

FLUORIDES

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FLUORIDES

- Fluoride is one of 14 physiologically essential elements for normal growth & development of human beings according to WHO expert committee on trace elements.
- "Fluorine" latin term 'Fluore' means to flow.
- 5% Indian population lives in endemic fluoride areas .
- 3% lives in optimal fluoride areas.
- 85-90% live in fluoride deficient areas.

Historical evolution of Fluoride

- Dr Fredrick McKay arrived in Colarado Springs after doing his graduation from University of Pennsylvania in 1901
- He noticed many of his resident patients having an apparent permanent stain....which he called Colarado stain.....he called stain "mottled Enamel" which was characterized by 'minute white flecks, or yellow or brown spots or areas , scattered irregularly or streaked over surface of a tooth, or it maybe a condition where entire tooth surface is of a dead paperwhite like color of a china dish

- In 1905, McKay moved to St Louis to practice orthodontics for 3 years where he did not see a single case of mottled enamel
- In May 1908, meeting he revived the question at El Paso Country odontologic society.....who sent him with a patient to state dental association in Boulder
- There he learnt of similar conditions in several other towns
- He then approached Dr G V Black in Chicago who promised to look into it in 1909

- In 1912 , Mc kay found an article written in 1902 by J M Eager reporting unusual occurrence of brownish colored stains amongst people of Naples
- In 1916, McKay along with Dr G V Black conducted studies in 26 different communities in various parts of USA and concluded that an unidentified factor was responsible for mottling of enamel.
- In 1931, Churchill H V, a chemist in New Kingston Pennsylvania identified presence of Fluoride in Bauxite through spectographic analysis [13-17ppm]

History of water fluoridation

- 1901-Dr Frederik Mckay of Colarado noticed permanent stain on tooth....Colarado stain. He called it Mottled enamel.
- In 1916 he contacted Dr G V Black, 1917 published it as endemic imperfections of teeth.
- He noticed decrease in prevalence of caries in mottled teeth.
- Dean continued the studies & summarized results in 1928 to APHA. He classified mottling in 1934. & did a 21 cities study.

Shoe leather survey

- Dr. Trendley H Dean conducted this survey in 22 cities in 10 states in 5824 12-14 years children of USA & gave following report:

1. High concentration of F in water is directly related to the severity of enamel mottling.
2. Enamel mottling was widespread in areas with water having F content of 3 ppm.
3. Mottling with discrete pitting of enamel was noticed at F levels of 4 ppm
4. Mottling was less in cases 2.5-3 ppm F levels; dull chalky white areas.
5. No mottling or any other enamel changes in areas with water containing 1 ppm F.

1942 he discovered that there was a 60% reduction in caries with 1ppm F drinking water.

Grand Rapids, USA : world's first artificial Fluoridation plant; 1945.

- In 1934, he developed a standard system of classification of dental fluorosis…the ‘mottling index’
- In 1942, Dean et al made an important milestone discovery that at 1ppm F in drinking water, 60% reduction in caries experience was observed
- In 1945, world’ s first artificial fluoridation plant at Grand Rapids , USA
- In 1946, Klein examined children of Japanese community transferred to Arizona, where water was 3ppm, observed:

Teeth in process of eruption, received max benefits of F

Teeth exposed to Fluorides shortly after eruption were also protected, although to a lesser degree

Sources

- Water, tea(100-400 ppm) ,dried fish(84.9 ppm) salmon(19.3 ppm), turmeric, jowar, bananas, potatoes(6.4 ppm), rock salt(40-200ppm)
- Mineral water: 1.5- 7 ppm.
- Excretion: through kidneys 20-30% within 3-4 hours.
- Tends to deposit in calcified structures; be it physiological/ pathological.
- Early stages of tooth development, enamel porous, Fluoride is absorbed preferentially

Daily intake of Fluorides

- Total intake: 0.05-0.07 mg of Fluoride per Kg of body weight.

- Total daily intake:1.7-3.3 mg.
- Adults: 2.2-3.2 ppm; children: 1-1.2 ppm per day.
- 1 ppm= 1gm/1000 litres= 1mg/l.
- 1 tab NaF of 2.2mg= 1 mg F

Fluoride Homeostasis

- It is defined as dynamic equilibrium between fluoride uptake and Fluoride excretion.
- Absorption: mainly from GIT (mainly from stomach & intestine). But also from air borne. (lungs)
- Metabolic uptake is influenced by nutrition, altitude & renal activity.
- Ca & high protein diet inhibits F absorption
- Disturbance in renal function enhances F retention

Fluoride Homeostasis

- F in blood: max in 30-60 minutes of ingestion…normal after 24 hours….plasma 0.25ppm-0.02ppm.
- F in saliva: 0.01ppm-0.05ppm
- F in milk: 0.02-0.05ppm F in humanmilk;cow milk more
- F in mineralised tissues: skeletal tissues & teeth

Fluoride Homeostasis

- Excretion
- Via kidney: 30-50ml/min

Younger children: more absorption….less excretion

- Via faeces & sweat: less quantitative importance
- In temperate climates, excretion by sweating is negligible

FLUORIDE BIOMARKERS

- Contemporary (urine, plasma, & saliva)
- Recent markers (nail & hair)
- Historic markers (bone & teeth)

Developing Enamel & F

- During early stages of development, smaller crystallites in enamel take up F readily. Porous enamel absorbs F preferentially; zone of high F enamel is found just before enamel begins to mineralize rapidly.
- F content:
- (CBDE) cementum(4500)>bone>dentin >enamel(2200-3200).
- Max F in Cementum.

Facts

- Deciduous teeth do not show mottling because primary teeth have a short pre-eruptive maturation period.
- F helps mineralization of white spot lesions only if the surface of enamel is intact.
- At 1ppm F, 60% REDUCTION IN CARIES.
- Avg DMFT in India: 3 (by age of 15)

FLUORIDES:ERUPTED ENAMEL

- Fluoride interferes with process of maturation, prolongs time during which enamel is porous, will thus extend the period of rapid Fluoride uptake.
- In fully matured enamel, gels / pastes 1000-10,000 ppm create porosity or destruction of apatite lattice-----highly mineralized enamel .
- Accumulation restricted to the surface region. Penetration into fully mineralized enamel is very slow.

MECHANISM OF ACTION Of FLUORIDES

- Anticaries effect of F:

a) F & Hydroxyapatitte crystals

- Decreasing solubility
- Improving crystallinity

b) F & remineralisation of teeth

c) F & Oral bacteria

d) F & Enamel surface

-desorbs proteins and bacteria (reduces plaque accumulation)

-lowers free surface energy(decreases wettability of enamel)

e) F & morphology of teeth

MECHANISM OF ACTION Of FLUORIDES

1) By rendering enamel more resistant to acid dissolution

- Under the influence of Fluorides:
- i) Larger crystals are formed with fewer imperfections- this stabilizes the lattice & presents a smaller surface area per unit volume for dissolution by forming fluoroapatite.
- ii) Enamel has a lower carbonate content thus giving reduced solubility.
- iii) Reprecipitation of Ca phosphate occurs & Fluoride favors their crystallization as apatite.
- Increases enamel resistance/reduction in enamel solubility: presence of F reduces the solubility of enamel by promoting the precipitation of HA & phosphate mineral.

Mechanism

2) By inhibiting bacterial enzyme systems which convert sugars into acids in plaque.

Higher conc: bactericidal;

lower conc: bacteriostatic

- For this to occur, Fluoride must be as free ionic fluoride & not be bound up in plaque.

3) By inhibiting storage of intercellular polysaccharides.

- In this way accumulation of carbohydrates within the bacterial cell is prevented.

Mechanism

4) By reducing the tendency of enamel surface to adsorb proteins.

- Fluoride reduces the surface energy of the teeth & the tendency of the enamel surface to adsorb proteins.

5) Modification in size & shape of teeth

- Animal experiments suggest that Fluoride intake during tooth development may reduce the size of teeth & produce more rounded cusps & shallower fissures.

Mechanism

6) Remineralisation of incipient lesions

Fluoride favors precipitation of Ca^{+2} & PO_4^{-2} ions in the form of apatite .It accelerates the growth of enamel crystals that have demineralization.

7) Increases the rate of post eruption maturation (apposition of minerals in hypomineralised areas)

8) Reduces the rate of demineralization.

Topical Fluoride Agents:

Indications

- After age 2, 6-8 years, 11-14 years
- Patients with xerostomia, Sjogren's syndrome, radiation treatment.
- Several new cavities, or areas of demineralization
- Past caries experience
- After periodontal surgery –root exposure
- Mentally & physically retarded individuals
- Patients with fixed/ removable prosthesis & after placement or replacement of restorations

FLUORIDE VEHICLES:

1. ACQUEOUS SOLUTIONS & GELS
2. FLUORIDATED PROPHYLACTIC PASTES:1% NaF for children
3. FOAM:APF
4. FLUORIDE VARNISH Duraphat [22600 ppm NaF], fluorprotector {7000 ppm F} biannual applications
5. FLUORIDE DENTIFRICES: NaF , SnF_2, monofluorophosphates, amine fluorides

Topical Fluorides

2 Broad categories:

- Professionally applied products
- Self applied products.

METHODS OF APPLICATION OF TOPICAL FLUORIDES

1. Paint on technique
2. Tray technique

- applied by the dentist [twice a year]
- can be self applied as home procedure [1 or more times a day]
- Contact with tooth for 5 minutes; expectorate excess gel & not to swallow
- Home F gels not recommended for children below 6 years.

RECOMMENDATIONS FOR TOPICAL APPLICATION -Tray

1. NO MORE THAN 2 G. OF GEL PER TRAY/ APPROX 40% OF tray capacity should be dispensed. Even more conservative for kids
2. Use a saliva ejector as patient may need to swallow in that 4 minute period
3. Following the 4 minute application patient should expectorate thoroughly for 30 sec -1 minute even if high speed suction is used.
4. 5-10 drops of products per tray if using daily/weekly application of high fluoride conc. product

Recommended schedule for use of F dentifrice

- < 4 years: F toothpaste not recommended
- 4-6 years: brushing once with F dentifrice & twice without paste.
- 6-10 years: brushing twice daily with F toothpaste & once without paste
- >10 years: brushing daily with F toothpaste thrice

Preparation of Fluoride compounds

- 2% Sodium Fluoride: 20gms NaF powder in 1 liter distil water
- 8% -10% Stannous Fluoride: dissolve one capsule 0.8gms is dissolved in 10 ml of distilled water
- 1.23%APF:20gms of NaF dissolved in 1 liter of 0.1M phosphoric acid and to this is added 50% hydrofluoric acid to adjust pH 3.....called brudevold' s solution

NaF:

- Knutson technique - 2% solution.

1. Crowns cleaned using rubber cup & Prophylaxis paste.
2. 2% solution applied to teeth in an isolated & dried quadrant.
3. Teeth were allowed to remain moist with solution for 3-4 minutes & not to rinse/eat for 30 min. to prolong effect.
4. Application was repeated on other quadrants.
5. 2^{nd}, 3^{rd}, 4^{th} applications, not preceded by prophylaxis were given at intervals of about 1 week.
6. Treatments were recommended at 3, 7, 11 & 13 years of age to coincide with eruption of new teeth.

- 30-40 % reduction in caries among children living in low Fluoride areas.

NaF:

Adv. Of NaF:

1. Stable chemically when stored.
2. Acceptable taste.
3. Nonirritating to gingiva
4. No discoloration.

Disadv. Of NaF:

- Patient must make & visits within a relatively short time.

Stannous F:

- 8%-10% annual application
- More effective than NaF.
- 59% reduction in dental caries.

Technique:

1. Prophylaxis + polish with pumice for 5-10 sec; unwaxed dental floss.
2. Isolation of quadrant.
3. Freshly preparation 8% soln. applied continuously to teeth with cotton applications, so that enamel surfaces are kept moist for 4 minutes. 15-30 sec application too is adequate.
4. In highly susceptible-application every 6 months otherwise once a year.

Stannous F:

Disadv.:

1. Not stable in aqueous soln- undergoes rapid hydrolysis & oxidation.
2. disagreeable in taste- unpleasant. Flavoring agents contraindicated.
3. Reversible tissue irritation shown by gingival blanching- occurs in patients with poor gingival health.
4. Pigmentation & staining of teeth usually appears in association with carious lesions, hypo calcified areas of enamel & around margin of restorations.

Acidulated phosphate Fluoride (APF) /

Brudevold's solution

- increased uptake of Fluoride

Technique:

- Prophylaxis: Solution applied to dried & isolated quadrant- keep enamel moist for 4 minutes.

ADV:

1. Chemically stable when stored.
2. Cost – self applied
3. Not stain enamel surfaces or pellicle.
4. Not astringent to gingival tissues.
5. Effective caries preventive agent.
6. Enamel takes up significantly more F from APF than other F Agents.

7.2 applications/year

APF

- Disadvantages:

1. Sour & bitter taste
2. Cannot be stored in glass
3. Repeated or prolonged exposure to porcelain causes roughening/ cosmetic changes.
4. Repeated appllication, use of suction; more chair side time.

APF Foam

Increased the F content in outer 5 mm enamel similar to APF gel.

Advantages:

1. Small amt of agent is reqd(4:1)
2. Surfactant in foam reduces surface tension; penetrates interproximal surfaces.
3. Does not require suctioning.

Fluoride varnish

- Duraphat: 22600 ppm F as NaF in a neutral colophonium base
- Fluoroprotector: polyurethane base 7000 ppm F.
- Carex: 1.8% F
- Technique: prophylaxis-dry teeth (no cotton)-apply arch wise-mouth open 4 min- nothing for 1 hour- solids next morning.

SYSTEMIC FLUORIDES USED IN PREVENTIVE DENTISTRY:

- DIETARY F SUPPLEMENTS: NaF tablets, APF, CaF, KF

1. F drops with/without vitamins
2. F tablets with/without vitamins
3. Lozenges to be sucked slowly
4. Oral rinse supplements (swished & swallowed)

INDICATIONS: NO central water supply, areas where water fluoridation & salt water fluoridation not possible; in families where there is a high degree of mobility involving frequent changes in work areas

- Supplements to be given from birth to age 13-16 years----caries reduction of 60-65%.

FLUORIDE DENTIFRICES

- NaF
- Stannous Fluoride[stains, metallic taste]
- Monofluorophosphate
- Amine Fluoride: best
- Brushing twice better than once
- Little post dentifrice clinical rinsing for maximum effect.

Action of F dentifrices

- Physical: reduce the cariogenicity of plaque by disrupting and removing fermentable materials
- Chemical: Fluoride gets deposited in the porous enamel of the incipient lesions.

F mouth rinses

- Daily daily/weekly/ fortnightly
- Once daily….0.02%NaF/0.05% NaF
- Once weekly/ fortnightly: 0.2%NaF/0.5%NaF
- Indications: caries prone children above 6yrs, ortho patients, erosions & root caries, dentin & root hypersensitivity

SUPPLEMENTAL F dosage schedule according to F conc. of drinking water

AGE (years)	<0.3ppm	0.3-0.7 ppm	>than 0.7 ppm
Birth-2	0.25	0	0
2-3	0.5	0.25	0
3-14	1.0	0.5	0
2.2 mg NaF contains 1 mg F			

Fluoride Toxicity

ACUTE FLUORIDE TOXICITY:

- CLD DOSE:32-64 mg of F per kg of body weight (certainly lethal dose)
- STD : 8-16 mgF/kg of body weight (safely tolerated dose)

Signs & symptoms:

- Gastrointestinal: Nausea, vomiting, diarrhea, abdominal pain & cramps. (non-ulcer dyspeptic complain), headache
- Neurological: nervousness, depression, pareasthesia, paresis, tetany, CNS depression, & coma
- Cardiovascular system: weak pulse, hypotension, pallor, shock, cardiac irregularities& ultimately failure
- Blood chemistry: acidosis, hypocalcaemia & hypomagnesia

Emergency Treatment for F overdoses:

- <5 mg/kg: give Ca orally/ milk
- >5 mg/kg: empty stomach by inducing vomiting/ gastric lavage; orally soluble Ca i.e. milk, Ca gluconate, or Ca lactate solution.
- >15 mg/kg: admit to hospital; induce vomiting; cardiac monitoring: administer 10 ml of Ca gluconate intravenously slowly; maintain urine output with diuretics; supportive measure s for shock.

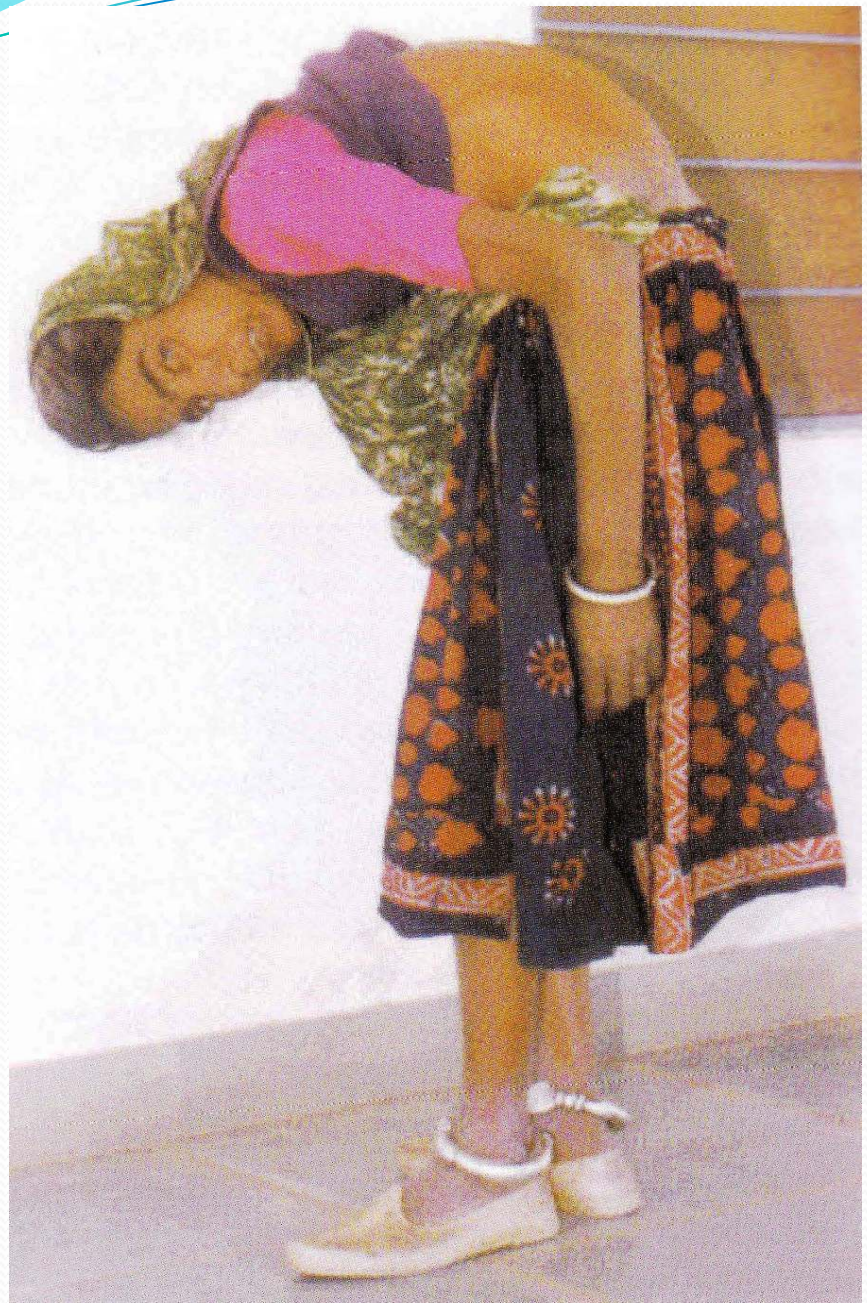
CHRONIC FLUORIDE TOXICITY:

DENTAL FLUOROSIS:

- Developmental phenomenon due to excessive F ingestion during amelogenesis. Once the crowns of the teeth are formed, **no further fluorosis** can be induced by additional intake of F or by posteruptive topical applications of F.
- Hypocalcified areas of mottled enamel are less soluble in acids, have a greater permeability to dyes & emit a higher fluorescence of higher intensity than normal enamel
- Fluorosis occurs symmetrically: premolars commonly affected followed by
- 2nd molar, Maxillary incisor & canine
- First molar & Mandibular incisors

SKELETAL FLUOROSIS:

- Severe pain in back bones, joints, hips, stiffness in joints & spine
- Outward bending of legs & hands in advance stage & these parts lose their shape & contour: KNOCK KNEE Syndrome
- Pregnant lactating mothers & children are the most vulnerable group
- F can damage foetus if mother consumes excess F during pregnancy
- F may lead to blocking & calcification of blood vessels causing cardiac problems
- 20-80 mg F per day for 10-20 yrs causes pathological skeletal fluorosis
- >20 years neurological manifestations.



Skeletal fluorosis

Non skeletal manifestations of Fluorosis

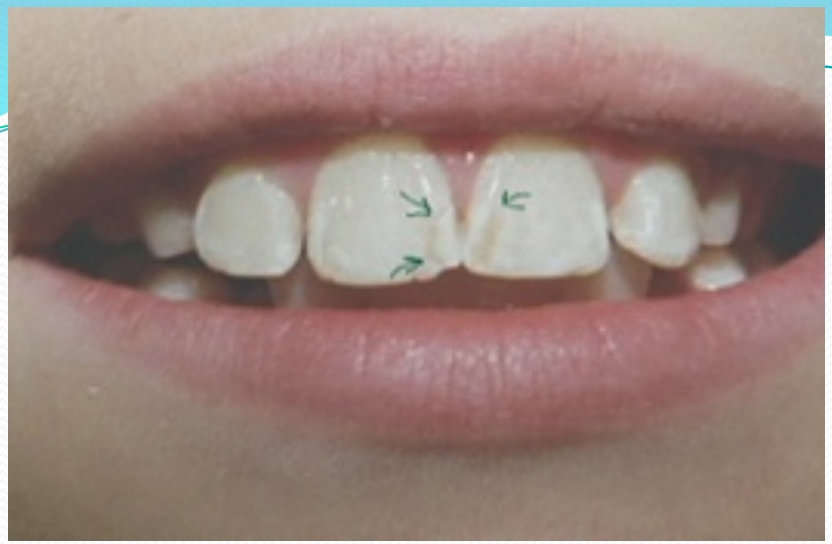
- GI complains, loss of appetite, pain in stomach, constipation with intermittent diarrhea
- Cardiac problems due to cholesterol production
- Repeated abortions/ still births
- Male infertility due to sperm abnormalities
- Muscle degeneration,
- Low Hb levels, deformities in RBCs,
- Excessive thirst, headache, skin rashes, nervousness, depression, urinary tract malfunctioning, abdominal pain
- Tingling sensation in fingers and toes
- Reduced immunity

Effects of Fluoride Level

FLUORIDE LEVEL	F In drinking water	EFFECTS
0.7-1.2 ppm	Depend ON THE TEMP OF AREA	PREVENTS DENTAL CARIES
1.5-3 PPM	CONSUMPTION OF WATER FOR 5-10 YEARS OR MORE	MILDER FORMS OF DENTAL FLUOROSIS
3.0-8 PPM	“ ”OVER 15-20 YEARS	SEVERE DENTAL FLUOROSIS & MILD SKELETAL FLUOROSIS
8 PPM OR MORE	“ ” 5-10 YEARS OR MORE	SEVERE FORM OF DENTAL & SKELETAL FLUOROSIS.

Dean's Fluoride Index

DEAN SCORE	CRITERIA
0	NORMAL enamel
0.5	QUESTIONABLE MOTTLING: few white flecks/ white spots
1	VERY MILD MOTTLING: small opaque pale white areas scattered <25% of the surfaces
2	MILD MOTTLING: White opaque areas more extensive but do not involve >50% of tooth surface
3	MODERATE MOTTLING: all enamel surfaces are affected & those subject to attrition show marked wear. Brown stain present.
4	SEVERE MOTTLING: all enamel surfaces are affected. Hypoplasia marked. Tooth form altered. Discrete /confluent pitting. Brown stains widespread, Corroded appearance



Score -1

Score - 2

Score-3

Score - 4

Treatment of Fluorosis

- Etching with hydrofluoric acid followed by bleaching with Hydrogen peroxide(30%).
- Acid etch technique followed by resin labial veneer restorations.
- In severe cases, crown placement can be done.

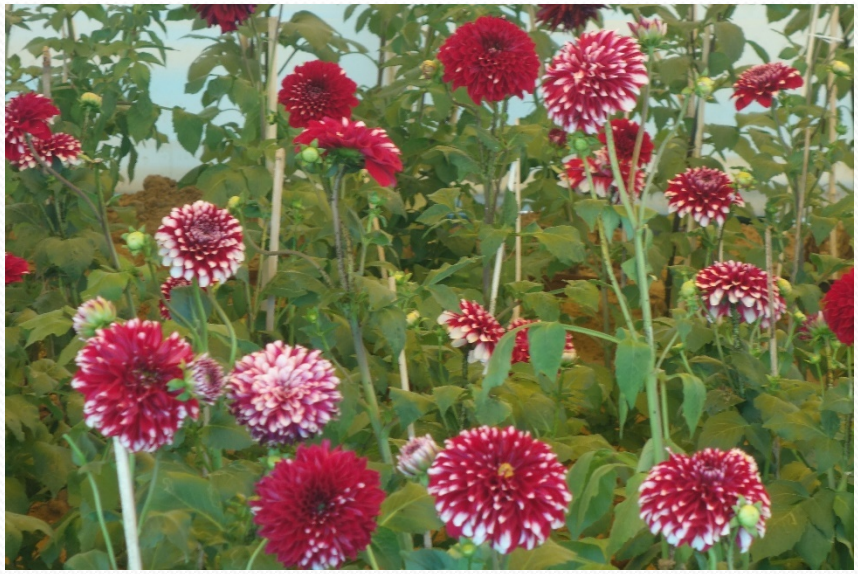
Prevention of Fluorosis

- Using alternate water sources like surface water, rainwater & low F groundwater
- Improving the nutritional status of population at risk: adequate calcium, Vitamin C ingestion
- Defluoridation of water

Fluoride analysis methods

500ml of water is collected in a a clean dry polythene container---2cc of 6N HCl is added to inhibit microbial growth----store at 4°C for analysis:

- Fluoride electrode coupled with standard pH meter
- Scot Sanchis method



COMMUNITY WATER FLUORIDATION:

Definition: controlled adjustment of the concentration of F in a communal water supply so as to achieve maximum caries reduction & a clinically insignificant level of fluorosis

- 40-50 % reduction in the caries prevalence in primary teeth, 50 -60 % in permanent teeth
- Optimum F conc:1 ppm of F—will give 1 mg F /day

Community water fluoridation schemes

- Grand Rapids – Muskegon study- Aurora

In 1945, NaF was added to Grand Rapids water supply, effects of 61/2 yrs study was done on 6 yr old & compared with Muskegon. Aurora natural F 1.4ppm

Caries experience almost half

Later Muskegon was fluoridated in 1951

- Newburgh – Kingston study: 10 yrs study; 57.9% reduction in 6-9 yrs; 53% in 10-12 yrs

Fluoridation of water

- Commonly used chemicals:

1. NaF powder- dry feeders.(most expensive)
2. Na silicofluoride powder- dry feeders. (cheapest,corrosive)
3. Hydrofluosilicic acid- solution feeders.....commonly used because of its low cost & ease of handling.
4. Fluorspar
5. Ammonium silicofluoride

Water fluoridation

- Volumetric dry feeder system delivers a pre-determined quantity of F in a given time interval.

  (dry feeder system)
- Acid feed system: small metering pump is used to add hydofluorosilicic acid to water system; most popular(saturator system)
- Venturi fluoridation system for smaller communities.(solution system)

Equipment used

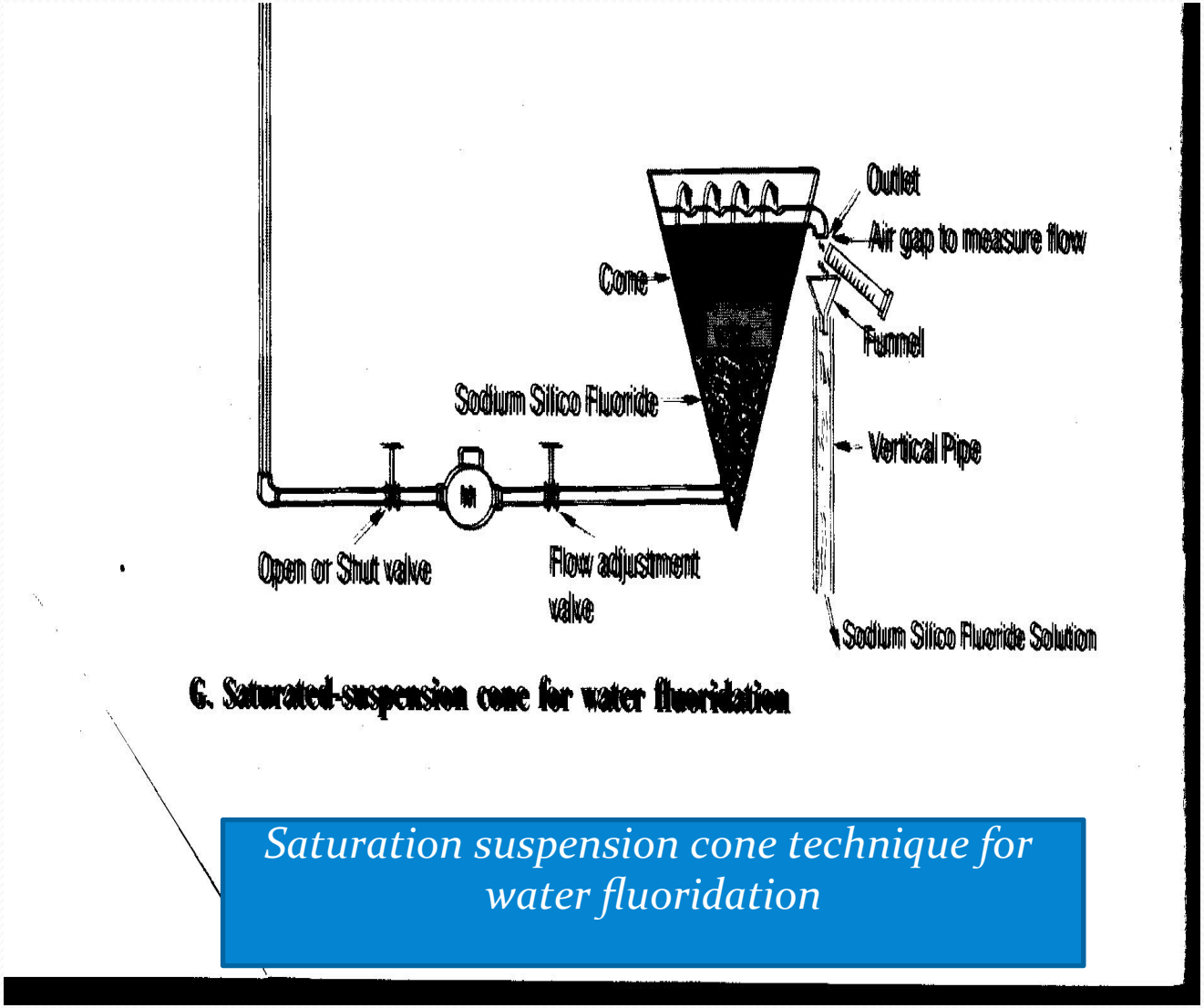
- Saturator system
- Dry feeder system
- Solution feeder system

Venturi fluoridator system

- Non electrical system (J N Leo)
- Activated by the flow of water in the main line of water
- No possibilty of accidental overdosage when water pump stops
- Tank is of clear acrylic thermoplastic
- Simple to install
- economical

Saturation suspension cone

- Dev in Brazil
- Consists of an upside down cone charged with a bag of Na Silicofluoride through which a constant flow of water percolates
- Solution is collected at the top by a horizontal perforated plastic pipe which forms the outlet
- Cone must be corrosion resistant (steel, fibreglass, PVC)
- 45 Kg Na silicofluoride bag is used; bag should not contain less than 25 Kgs



Saturation suspension cone technique for water fluoridation

Saturation suspension cone: Parts

- Cone: 0.91 m high, 0.91m diameter, mounted upside down on a tripod made of 2cm diameter rod
- Head tank (7-10m) for feeding water
- 2cm diameter connecting pipe from head tank to lower end of the cone. Shut off valve inserted in the line, as well as water flow meter. 2 cm inlet is reduced in diameter at lower end of the cone to 1.2cm
- Surface collector consisting of horizontal perforated 2.5cm diameter pipe collects the solution & discharges it into wide funnel, which is connected to 3.75 cm diameter pipe. Pipe feeds the solution to the point of application

Advantages of water fluoridation

- Consumers receive continuous protection with no conscious effort.
- Does not require costly services of health professional.
- No daily dosage to be remembered.
- Socially equitable---no discrimination.

Effects of water fluoridation

- 50-60% caries reduction in deciduous teeth if children are exposed since birth.
- Prevention of premature extraction of deciduous teeth.
- Among permanent teeth: caries reduction is 43% on pits & fissures, 74% on proximal surfaces, 88% on gingival surfaces (total 58%)
- If dental caries does develop, progress of lesion slows down

Benefits of water fluoridation

- 50-70% REDUCTION IN CARIES
- 75% reduction in first permanent molar loss.
- Reduction in no. of surfaces attacked by caries
- Prevents malocclusion
- Prevents osteoporosis in elderly women & pathological fractures.
- Prevents old age hearing loss due to prevention of osteosclerotic changes

Limitations of water fluoridation

- Can be implemented only if there is centralized water supply
- Initial cost of installing plant is more.
- No choice left with the patient.

Salt fluoridation

- 250mg of F/kg salt recommended
- Introduced in Switzerland, poupular in Colombia, Hungary & Spain.
- Economical, practical, 40-50% caries reduction.
- Disadv: salt consumption negligible till 4-5 yrs after birth; cannot be used in hypertensive & renal failure patients.

Milk fluoridation

- Introduced IN SWISS CITY.
- 2.2 mg NaF(1 mg F) added to ¼ litre of milk
- Recommended for children & milk consumption begins before eruption of permanent teeth.
- Caries reduction 60%.
- Poor children drink less milk; parent cooperation required, costly

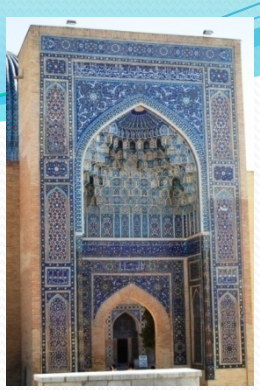
School water fluoridation

- 4.5 -6.3 ppm F
- High concentration is recommended because less no. of school hours.
- Economical
- Developmental stage of teeth....

DEFLUORIDATION OF WATER

- Endemic F belts: A.P.,Gujarat, Rajasthan ,Punjab, Haryana,M.P., Tamilnadu
- 70-100% districts affected in A.P.,Gujarat, Rajasthan
- High F belts in Gujarat: Kutch & West Jamnagar 4-8 ppm.
- Nalgonda technique: 1961 NEERI: National Environmental Engineering Research Institute-Nagpur.

Defluoridation



- It is defined as Downward adjustment level of Fluoride ion concentration in drinking water so that the level of Fluoride is maintained at the normal physiologic limit of 1ppm to prevent dental caries with minimum possibility of causing dental fluorosis
- Can be done by 2 methods:

1) Based upon ion exchange process or adsorption
2) Based on addition of chemicals to water during treatment

DEFLUORIDATION

- Adsorption method: carried out by running fluoridated water over contact bedswhere F is removed by ion exchange or chemical reactions with agents comprising bed matrix.
- cation exchange resins:
- 1. DEFLUORON 1: a sulphonated saw dust impregnated with 2% alum solution
- 2.CARBION : good durability & can be used on sodium & hydrogen cycles.
- 3.MAGNESIA: removes excess F but pH of treated water was beyond 10 & its correction by acidification / recarbonation was necessary
- 4. DEFLUORON 2: it is sulphonated coal & works on Al cycles

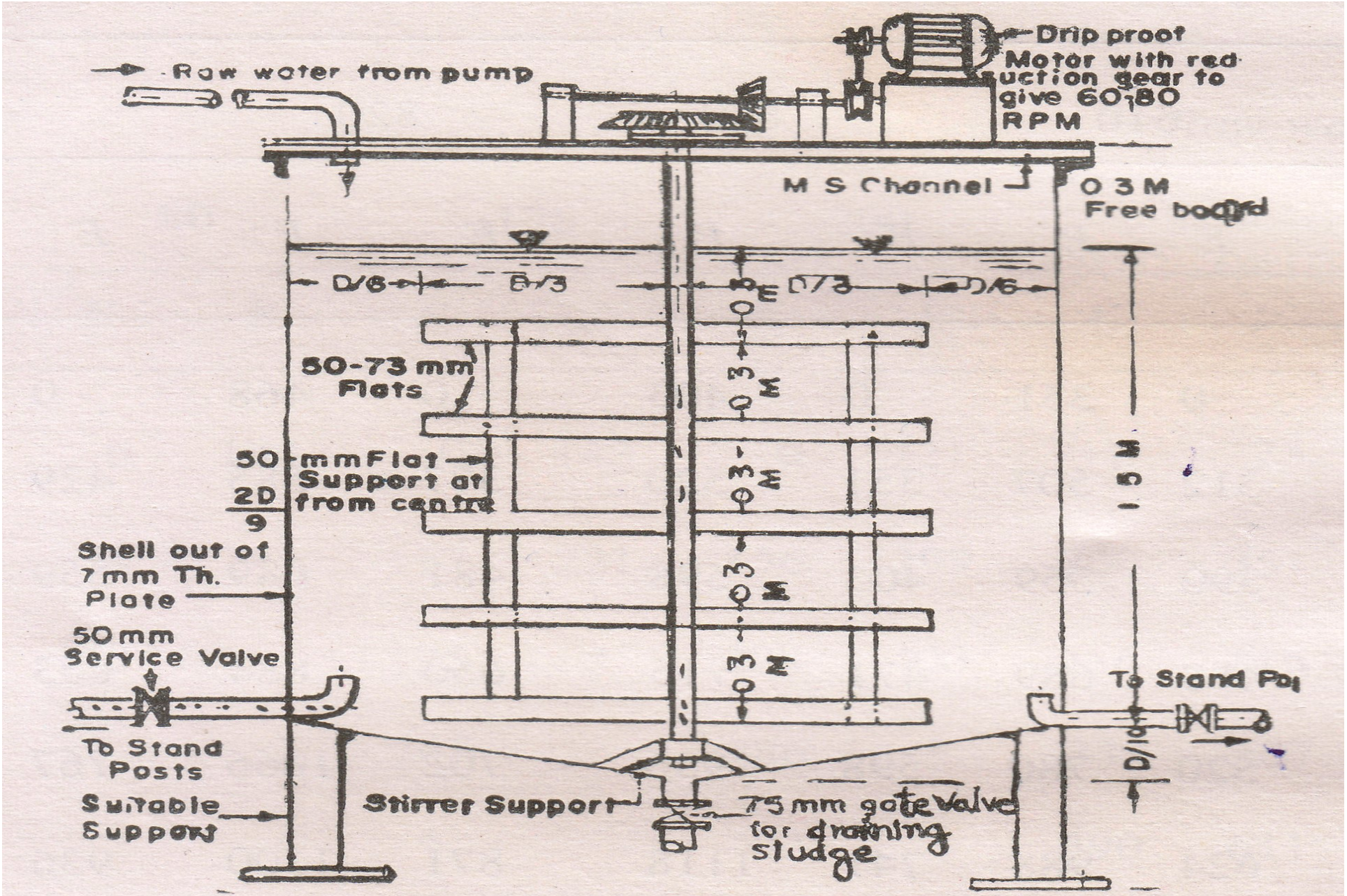
NALGONDA TECHNIQUE:

- Based on addition in sequence of Aluminium salts or filter alum **(coagulant),** (Al sulfate/ Al chloride or both)**, lime (1/20 dose of Al sufate) facilitates forming dense flocs for rapid settling Bleaching powder (disinfectant)** to F water
- followed by flocculation, sedimentation & filtration
- RAPID mixing: coagulant is rapidly & uniformly dispersed ---form microflocs: settlable particles---result in proper utilization of coagulant. [prevents localization of concentration & premature formation of hydroxides]
- FLOCCULATION: achieved by gentle & prolonged mixing. formation of settled particles/ flocs from destabilized colloidal sized particles
- SEDIMENTATION: Separation from water by gravitational setting of suspended particles that are heavier than water
- FILTRATION: Process for separating suspended & colloidal impurities from water by passage through porous media

DEFLUORIDATION

OPERATION OF NALGONDA FILTER:

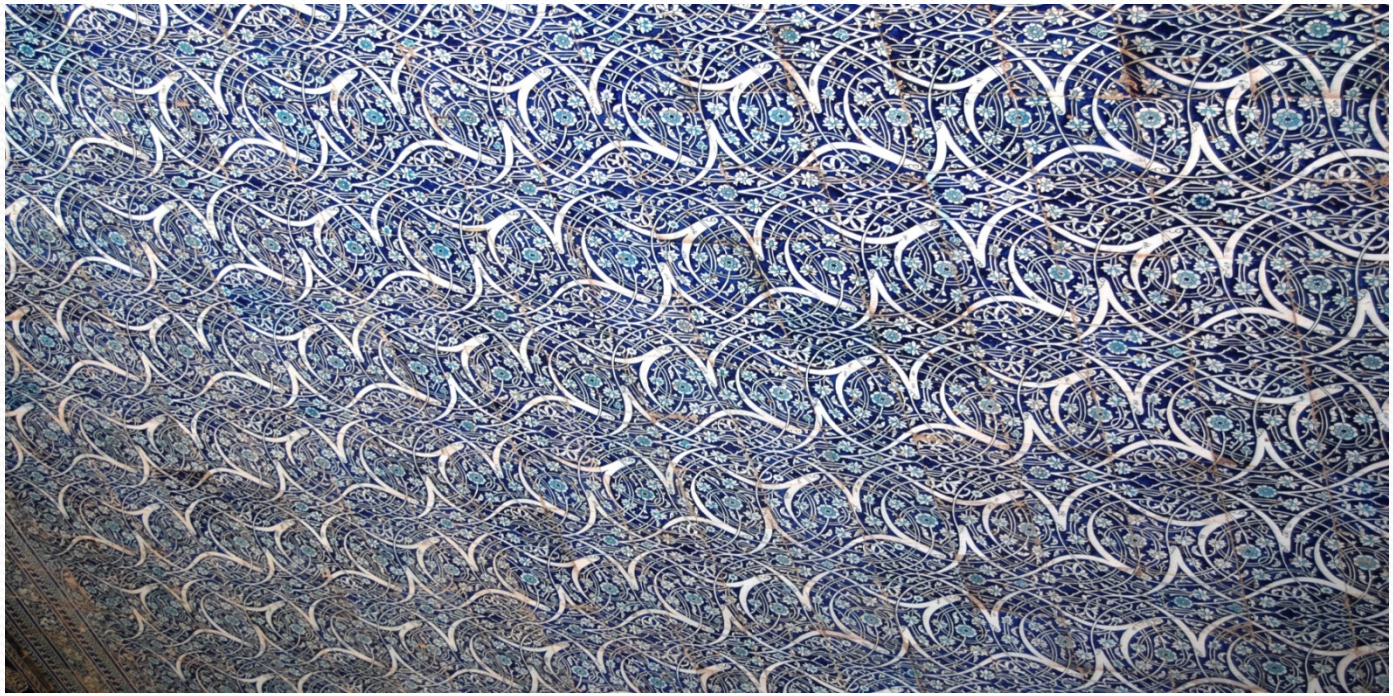
- 22 liters of water into the upper chamber---add required dose of Aluminium salt solution depending on the F conc of water------rapid mix for 30-60 sec with a speed of 10-20 rpm [so that coagulant is rapidly & uniformly dispersed]---on chemical reaction tiny flocs are formed-------slow mix for 10-15 minutes with a speed of 2-4 rpm-----flocculated water is allowed to settle & filter through candles overnight---treated water ready---wash filter daily.



FILL AND DRAW TYPE DEFLUORIDATION PLANT
BASIS: 15 lpcd DOMESTIC WATER

Cost effectiveness

- 1 filter 25l/batch: 400--700 Rs
- 400l capacity: 5 lakhs.



Domestic defluoridation

- Any company stainless steel candle filter adopting Nalgonda technique.
- Candle filter & an additional mixing device to be fitted inside the filter.

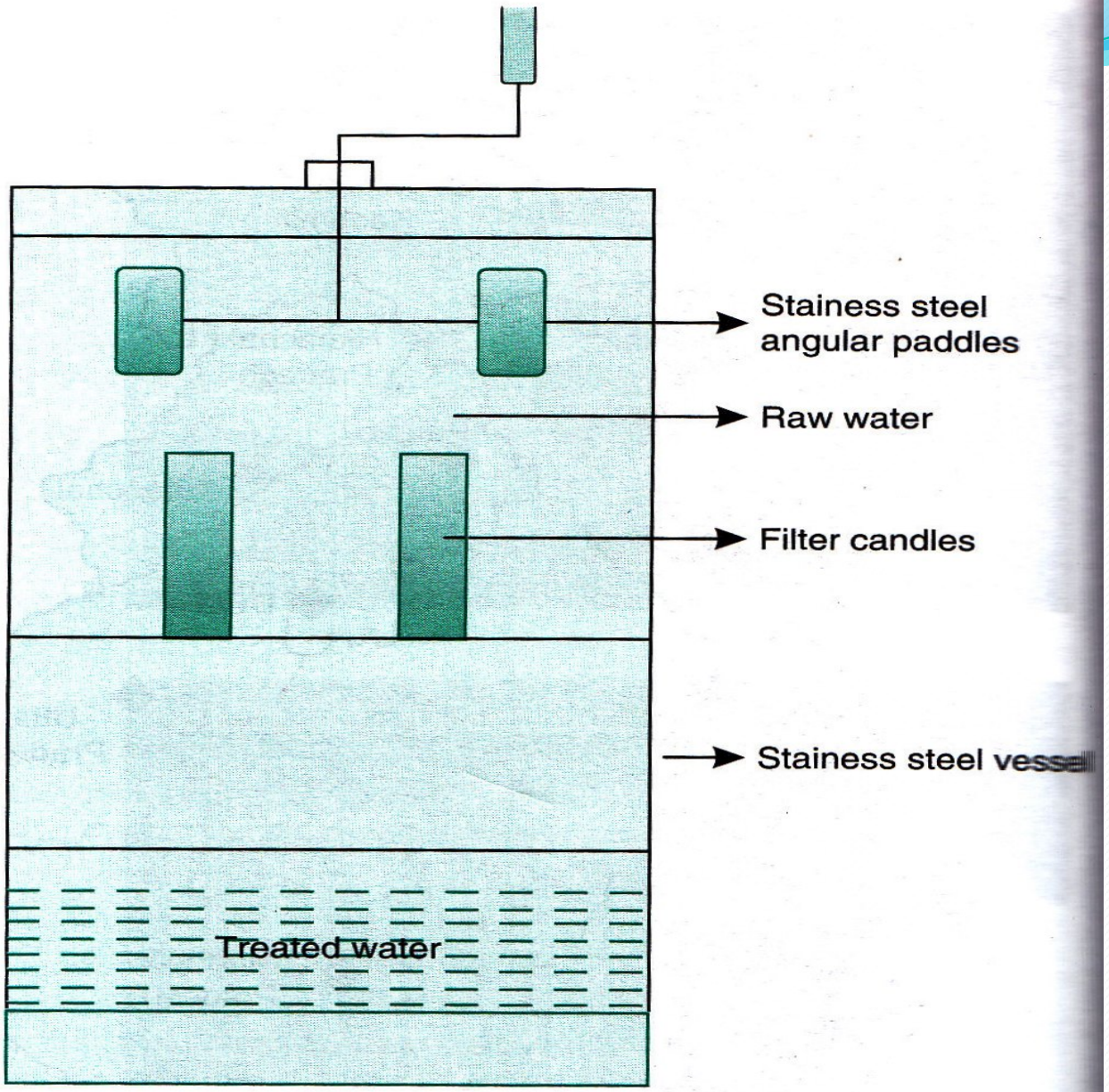


FIGURE 36-27 Stainless steel candle filter—Nalgonda technique.

Domestic defluoridation

- 60l capacity container/ bucket with tap 3-5 cm above
- Raw water mix with adequqte amount of Alsulfate solution(alum), lime or sodium carbonate & bleaching powder depending on alkanity
- Alum solution added ---mix well---add lime or Na2C03 and bleaching powder ---stir slowly for 20min...allow to settle for 1 hour.....remove water by tap

Membrane process

- RO (reverse osmosis): physical process in which the contaminants are removed by applying pressure on the feed water to direct it through a semipermeable membrane
- 98%F removed but it removes all ions present in water, even the ones which are required for growth & mineralization
- Expensive
- Water becomes acidic and requires correction
- Lots of water gets wasted as brine which needs to be disposed

Questions asked: theory

- History of evolution of fluoride
- Mechanism of action of Fluoride
- Topical action of F, Indications, topical application of F
- Fluoride homeostasis
- Water fluoridation
- Defluoridation
- Dean's Fluoride index
- Fluoride toxicity
- Shoe leather survey
- Colarado stain, domestic way of defluoridation, Knutson's technique
- Concentration of F in enamel, dentine and cementum
- Why is fluorosis not found in deciduous teethConcentration of F in enamel, dentine and cementum