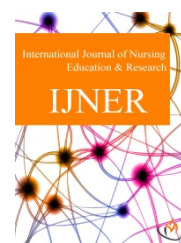




INTERNATIONAL JOURNAL OF NURSING EDUCATION & RESEARCH



Journal homepage: www.mcmed.us/journal/ijner

DEFLUORIDATION TREATMENT BY NALGONDA TECHNIQUE

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Article Info

Received 22/02/2014

Revised 15/03/2014

Accepted 18/03/2014

Key

words:Defluoridation,
Nalgonda Technique,
Method etc.

ABSTRACT

Defluoridation is removal of excess fluorides from water; Removal is achievable either by precipitation and complexation process known as Nalgonda Technique or by fixed bed generatable activated alumina process. The recommended defluoridation method is Nalgonda Technique. Nalgonda Technique is a simple and economical process which can be adapted by a common man. It can be adapted at domestic as well as community level. Both fill-and-draw and continuous operation systems can be installed for defluoridation of water for community water supply. Nalgonda Technique is effective even when the dissolved solids are above 1500 mg/l and hardness above 600 mg/l.

INTRODUCTION

Defluoridation is removal of excess fluorides from water; Removal is achievable either by precipitation and complexation process known as Nalgonda Technique or by fixed bed generatable activated alumina process [1]. The recommended defluoridation method is Nalgonda Technique. Nalgonda Technique involves additional of aluminium salts, lime and bleaching powder followed by rapid mixing, flocculation sedimentation, filtration and disinfection. Aluminium salt may be added as aluminium sulphate or aluminium chloride or combination of these two. Aluminium salt is only responsible for removal of fluoride from water [2]. The dose of Aluminium salt increases with increase in the fluoride and alkalinity levels of the raw water. The selection of either aluminium sulphate or aluminium chloride also depends on sulphate and chloride contents of the raw water to avoid exceeding their permissible limits [3, 4]. The dose of lime is empirically 1/20th that of the dose of aluminium salt.

Lime facilitates forming dense flock for rapid setting. Bleaching powder is added to the raw water at the rate of 3mg/l for disinfection [5]. Nalgonda Technique is combination of several unit operations and process incorporating rapid mixing, chemical interaction, flocculation, sedimentation, filtration, disinfection and sludge concentration to recover water and aluminum salt . Nalgonda Technique is a simple and economical process which can be adapted by a common man. It can be adapted at domestic as well as community level [6]. Both fill-and-draw and continuous operation systems can be installed for defluoridation of water for community water supply. Nalgonda Technique is effective even when the dissolved solids are above 1500 mg/l and hardness above 600 mg/l [7].

METHOD: There are following steps:

- **Rapid Mix:** Provides thorough mixing of alkali, aluminium salts and bleaching powder with the water. The chemicals are added just when the water enters the system [8, 9].
- **Flocculation [10 – 18]:** Flocculators provide subsequent gentle agitation before entry to the

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• sedimentation tank. The flocculation period permits close contact between the fluoride in water and polyaluminic species formed in the system. The interaction between fluoride and aluminium species attains equilibrium. The chemical reaction involving fluorides and aluminium species is complex. It is a combination of polyhydroxy aluminium species complexation with fluorides and their adsorption on polymeric aluminium hydroxides (flock). Besides fluorides, turbidity, colour, odor, pesticides and organics are also removed. The bacterial load is also reduced significantly. All these are by adsorption on the flock. Lime or sodium carbonate ensures adequate alkalinity for effective hydrolysis of aluminium salts, so the residual aluminium dose not remains in the treated water. Simultaneous disinfection is achieved with bleaching powder and also keeps the system free from undesirable biological growths.

• **Sedimentation [19 – 22]:** Permits settle able flock loaded with fluorides, turbidity, bacteria and other impurities to be deposited and thus reduces concentration of suspended solids that must be removed by filters. Sedimentation theory is complex and of little avail, because flock is not uniform and hence it's basic sedimentation properties cannot be given quantitative values and because the influence of eddy currents cannot be predicated. Hence, various factors which influence sedimentation in relation to design and operation rely largely on experience.

• **Filtration [23 – 26]:** Rapid gravity sand filters are suggested to receive coagulated and settled water. In these filters unsettled gelatinous flock is retained. Residual fluorides and bacteria are absorbed on the gelatinous flock retained on the filter bed.

• **Disinfection and Distribution:** The filtered water collected in the storage water tank is re-chlorinated with bleaching powder before distribution [27].

Features of Nalgonda Technique [28, 29]:

- No regeneration of media.
- No handling of caustic acids and alkalies.

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- Readily available chemicals used in conventional municipal water treatment are only required.
- Adaptable to domestic use.
- Applicable in batch as well as in continuous operation to suit needs.
- Simplicity of design, construction, operation and maintenance.
- Local skills could be readily employed.
- Highly efficient removal of fluorides from 1.5 to 20 mg F/l to desirable levels.
- Simultaneous removal of colour, odor, turbidity, bacteria and organic contaminants.
- Normally, associated alkalinity ensures fluoride removal efficiency.
- Sludge generated is convertible to alum for use elsewhere.
- Little wastage of water and least disposal problem.
- Needs minimum of mechanical and electrical equipment.
- No energy except muscle power for domestic equipment.

When to Adopt Nalgonda Technique [30]:

- Absence of acceptable, alternate low fluoride source within transportable distance.
- Total dissolved solids are below 1500 mg/l; desalination may be necessary when the total dissolved solids exceed 1500 mg/l, the cause for rejection limit in the absence of alternate source.
- Total hardness is below 600 mg/l, the 'cause for rejection' limit in the absence of alternate source. Hardness does not interfere in the defluoridation.
- Hardness > 200 mg/l becomes a cause for rejection or adoption of desalination. Between 200 mg/l and 600 mg/l hardness precipitation softening techniques supplement Nalgonda Technique and, such waters are to be dealt individually on merits.
- Alkalinity of the water to be treated must be sufficient to ensure complete hydrolysis of alum added to it and to retain a minimum residual alkalinity of 1 to 2 mg/l, in the treated water to achieve water pH between 6.5 and 8.5.
- Raw water fluorides ranging from 1.5 to 20 mg F/l.



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