NORTHERN ARIZONA UNIVERSITY

Memorandum

To: Terry Baxter - Technical Adviser, Alarick Reiboldt - Grading Instructor
From: Alex Anzar, Shelby Carawan, Paige Reilly, Cameron Rhodes - ASCE Environmental Team
Re: System Component Research

Purpose: The following internal memo contains a thorough analysis of the various water treatment methods that the team is considering for the system design.

1.0 Summary

1) Turbidity
    a) Screening
    b) Rapid sand filtration
    c) Sari cloth filtration
    d) Zeolite filtration
2) Nutrients
    a) Resin
    b) Hydrotalcite
3) Coliforms
    a) Chlorination
    b) Activated carbon
4) Odor
    a) No treatment method specific for odor

2.0 Turbidity

1) Filtration through multiple layers of sari cloth has been shown to reduce cholera transmission in Bangladesh by removing the copepods to which the cholera bacteria are attached [1].
2) Filtration through clean sand is a fast and simple pre-treatment option. The benefits of sand filtration are that it is effective at removing some bacteria, it is simple and fast for the user, and, if sand is available locally, it is inexpensive [2].
    a) Rapid sand filtration is common in developed countries for the treatment of large quantities of water where land is a strongly limiting factor, and where material, skilled labour, and continuous energy supply are available [2].
        i) Somewhat effective for odor and organic matter.
3) Zeolite filtration media has consistently outperformed sand, sand/anthracite and multimedia in both pressure vessels and gravity filtration tests. Zeolite more effectively removes fine particles in the 0.5µ to 10µ range that escape conventional media [3].

3.0 Nutrients - NO_3, PO_3

1) Simultaneous removal of phosphate and nitrate using high-capacity anion-exchange resin is advantageous for the treatment process in that it combines otherwise separated processes into one process. The other treatment methods to be considered are biological removal, and reverse osmosis. However, due to the constraints of the competition, chemical removal of the nutrients is concluded to be most practical [4].
    a) The simultaneous removal of phosphate and nitrate was conducted by using a commercialized resin. The research article compares the commercialized resin with the group's own synthesized resin. For both resins the amount of nitrates and phosphate were significantly reduced. During the testing phase, each resin that has proven capabilities in reducing nitrates and phosphates, will be used to determine the best design for the system. All constraints and criteria will be taken into account when choosing the final treatment method for nutrines [5].

2) In this article the author researched the removal of nitrates and phosphates, through the use hydrotalcite, which is a clay mineral ion exchange media. This article is a valuable source as it considers removing both nutrients. This method considers the concentration of each nutrient, and how it affects the removal rate of nitrates and phosphates. Phosphate removal remained over 95% removal, while nitrate varied with the total concentration [6].

4.0 Total Coliforms

1) Chlorination can kill most disease causing organisms but not all pathogens and organisms attached to particles.Turbid water must be filtered first before disinfection to increase the effectiveness of the chemicals [7].
    a) 0.14 mL or 0.45 mg chlorine per 35 liter sample
2) Chlorination is still the most common disinfection method in the United States, although recent concerns have been raised about the reaction of chlorine with organic matter in water. Such a reaction can result in the formation of trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform), which are suspect carcinogenic compounds [8].
3) For trihalomethane removal, aeration - either by diffused-air or with towers - and adsorption - either by powdered activated carbon or granular activated carbon - are effective [9].

5.0 Odor

1) The odor parameter was added as a quality assurance test. If the system is properly designed to bring the simulated water to drinking water standards, then the system should eliminate the lavender extract.

5.0 References

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