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Fuzzy Sludge Quality Index on the basis of Fertilizer Potential after Primary Clarifier

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Abstract

The sludge is generated from the two treatment units of Sewage Treatment Plant (STP) like primary and secondary clarifier. In the activated sludge process, the sludge produced after secondary clarifier can be recycled and wasted sludge can be used as fertilizer after sludge treatment. The chemical sludge produced from primary clarifier is not suitable to be used as fertilizer because of the use of chemical coagulants for coagulation process. As considering this problem, a pilot plant study was done using natural coagulants to produce pure bio sludge. A methodology is also developed for ranking of different STPs on the basis of fertilizer potential of sludge from primary clarifier by developing Fuzzy Sludge Quality Index (SQI). A case study of three STPs which are located in Pimpri Chinchwad Municipal Corporation, Pimpri, Pune, Maharashtra, India is also incorporated in this study.

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Keywords: Fuzzy Sludge Quality Index; Multi Criteria Desion Making; Ranking of STPs; Fertilizer Potential and Natural Coagulants.

1. Introduction

The treatment of sewage or waste water is a nuisance and costly affair for concern authorities. Similarly, using chemicals for treatment, leads to degradation of environment.

An attempt has been made in this study to resolve this issue. Actually, generated bio-sludge after secondary

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clarifier of sewage treatment plant can be used as fertilizer. The use of natural coagulant is an option for chemical coagulant is suggested in this study. A pilot plant model is developed for this study. Babul [Acacia nilotica] and Mango [Mangifera indica] seeds are selected as natural coagulants. The sludge generated after primary clarifier using these natural coagulants was analyzed. A methodology is also developed for ranking of STPs on the basis of fertilizer potential of sludge. For this Fuzzy Multi Criteria Decision Making [MCDM] approach is used for the determination of Sludge Quality Index [SQI] after primary clarifier. On the basis of SQI appropriate natural coagulant can be decided. In activated sludge process bio-sludge is produced after secondary clarifier and by using natural coagulant bio-sludge can be produced after primary clarifier also. This large quantity of sludge can be used as fertilizer, and the same can be provided with lowest cost to the farmer.

Use of Chemicals in treatment of sewage has less scope because of chemical cost, generation of more volume of chemical sludge and effect of chemicals over biological treatment process. The nutrients in sewage sludge can be effectively used as soil conditioner [9]. Lotfi A. Zadeh [13] developed the fuzzy set theory. Lad et al. [8] developed Pollution Potential Index for ranking of different types of industries. Jain [4, 5] proposed a methodology to rank alternatives on the basis of maximizing set. Bass and Kwakernaak [1] were introduced a concept of membership level. Jain et al. [6] studied effect of Mangifera Indica and Acacia Nilotica as natural coagulant to treat sewage. Pramod Kumar Raghuwanshi, et al. [11] analysed natural materials like Moringa Oleifera (Surjana seeds); Nirmali seed (Strychnos potatorum) and Maize (Zeemays) are as coagulants. Chun Yang Yin [2] studied natural coagulant sources, processes to extract coagulant from plant base sources, effectiveness and relevant coagulating mechanisms for treatment of waste water. Mishra M. Agarwal, et al. [10], studied treatment of sewage and tannery waste by Plantago Psyllium mucilage as a natural flocculation material to remove suspended solids.

2. Methodology

Methodology is divided in two parts.

1. For determination of optimum dose of the natural coagulants and sludge parametric values.
2. For ranking of STPs on the basis of fertilizer potential after primary clarifier.

2.1. Determination of optimum dose of the natural coagulants and sludge parametric values

2.1.1. Materials

Acacia Nilotica [Babul] fruits are collected from Marathwada region of Maharashtra state and seeds of Mangifera Indica [Alphonoso Mango] are collected from local Pune market.

2.1.2. Methodology

A pilot plant study was done for the generation of sludge. The STP primary units were designed for pilot plant study for sewage flow of 1 Mld and then the dimensions of units were finalized with scale of 25.

Mangifera Indica and Acacia nilotica seeds were grinded to a fine powder and stored in air tight container separately. 10 grams of powdered materials were diluted in distilled water using magnetic stirrer with a speed of 100 rpm for 15 minutes to prepare 1000 ml of solution. Then supernatant was passed through Whatman Filter Paper No. 40 and the filtered liquid collected as extracted natural coagulant, which has been used for further study work.

The samples were collected from STPs which are located in Pimpri- Chichwad Municipal Corporation area and studied through pilot plant model.

Optimum dosages for natural coagulants in combination with different proportions are determined by Jar test apparatus for different turbidity ranges.

Table 1 shows dosage of natural coagulants for different turbidity.