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A REVIEW ON LEACHATE TREATMENT OF SOLID WASTE DUMPING SITES IN BANGLORE

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Abstract - *Bangalore city generates about 4,500 metric tons of municipal solid waste every day in that 75% is disposed in the landfill. The landfill leachate discharge may lead to serious environmental problems. Leachate may percolate through landfill liners and subsoil causing pollution of ground water and surface waters resources. The aim of this research study the Leachate treatment of solid waste dumping sites in Bangalore. Landfill leachate contains various pollutants that can be categorized into four groups such as dissolved organic matter, inorganic macro components, heavy metals, and organic compounds. The pH of the leachate is considered as alkaline as the pH is 7.6 in Mavallipura landfill leachate. The results showed that the highest metal concentration that exists in the leachate was Iron which is about of 12 ppm. BOD3 and COD of the leachate are 1500 mg/L and 10400 mg/L, respectively. The leachate characteristics indicate favorable growth of algae in natural water contaminated with leachate with the alkaline condition and with the presence of magnesium as nutrient, which has been confirmed in the nearby surface pon.*

Key Words: **leachate, wastewater sample, analytical procedure, equalization basins, aerobic lagoons, sludge. Etc…**

1. INTRODUCTION

1.1 General

A leachate is any liquid that, in the course of passing through matter, soluble or suspended solids, or any other component of the material through which it has passed.

Leachate from a landfill varies widely in composition depending on the age of the landfill and the type of waste that it contains. It usually contains both dissolved and suspended material. The generation of leachate is caused principally by precipitation percolating through waste deposited in a landfill. Once in contact with decomposing solid waste, the percolating water becomes contaminated, and if it then flows out of the waste material it is termed leachate. Additional leachate volume is produced during this decomposition of carbonaceous material producing a wide range of other materials including methane, carbon dioxide and a complex mixture of organic acids, aldehydes, alcohols and simple sugars.

The risks of leachate generation can be mitigated by properly designed and engineered landfill sites, such as those that are constructed on geologically impermeable materials or sites that use impermeable liners made of geomembranes or engineered clay. The use of linings is now mandatory within the United States, Australia and the European Union except where the waste is deemed inert. In addition, most toxic and difficult materials are now specifically excluded from landfilling. However, despite much stricter statutory controls, leachates from modern sites are often found to contain a range of contaminants stemming from illegal activity or legally discarded household and domestic products.

1.2 Leachate treatment

Its quality is the result of biological, chemical and physical processes in landfills combined with the specific waste composition and the landfill water regime. With increasing leachate effluent quality standards, the efforts for leachate treatment also increase.

2. LITERATURE REVIEW

Massoud, Pirbazari, Varadarajan, RavindranBadri, N.Badriyha, Sung-HyunKim† U.S.A (February 1999), Title : Hybrid membrane filtration process for leachate treatment

A hybrid technology known as the ultrafiltration-biologically active carbon (UF-BAC) process that amalgamates adsorption, biodegradation and membrane filtration is found to be highly efficient for treatment of landfill leachates. The process employs bioactive powdered activated carbon (PAC) with a leachate-acclimated microbial culture for the simultaneous sorption and biodegradation of organic constituents. Tubular cross-flow ultrafiltration membrane modules separate out colloids and microorganisms, and a high quality permeate is obtained. The process efficiencies for both leachates were in the range of 95–98% in terms of TOC removal, and exceeded 97% for specific organic pollutants. The UF-BAC process compared well with the PACT process in terms of organic removal, and produced higher quality effluent in terms of suspended solids (100% removal). The study demonstrated that addition of 1% PAC mitigated permeate flux deterioration attributed to membrane fouling and concentration polarization, and enhanced permeate transport.

T.Maehlum -Norway (February 2000), Title : Treatment of landfill leachate in on-site lagoons and constructed wetlands.

This paper describes a biological treatment system, capturing leachate from a municipal sanitary waste (MSW) landfill on-site. The area has a typical cool temperate continental climate. The treatment system is built in a ravine and has been operating since July 1993. The average flow is estimated to be 120 m3 d−1. The low-strength leachate is first treated in a 400 m3 anaerobic pond. Stage 2 is a 4000 m3 aerated lagoon with 3 AIRE-O2 aspirator propeller aerators/mixers. Oxidation of organic matter, NH4−N and Fe take place in this lagoon. Stage 3 is two parallel constructed wetlands (CWs) with horizontal subsurface flow, each with an area of 400 m2. The filters consist of (i) washed gravel and (ii) Light Expanded Clay Aggregates, LECA (size range 10–20 mm). The CWs were planted with Phragmites australis and Typha latifólia. Stage 4 is a 2000 m2 free water surface CW, planted with Scirpus and Typha. The integrated system has no moving parts, except for the aerators. The overall removal of organic matter, N, P, Fe and pathogens is promising (70–95%). The paper presents combinations with the use of conventional and natural systems in MSW landfill leachate treatment.

Hee-Chan Yoo, Soon-Haing Cho &Seok-Oh Ko - Korea (2001), Title : Modification Of Coagulation And Fenton Oxidation Processes For Cost-Effective Leachate Treatment. Physicochemical processes have been used to remove nonbiodegradable organic compounds in leachate generated from sanitary landfills. In this study, a coagulation process combined with Fenton oxidation was evaluated for the removal of refractory organics in leachate. Recycling of sludge generated from Fenton oxidation to a coagulation process was attempted to reduce operation cost and to improve organic removal rate. The addition mode of Fenton reagent was also modified to obtain a better organic removal rate and more cost-effective operation. With Fenton sludge recycling, 9% higher COD removal was obtained, and the sludge to be disposed could be reduced up to 50%. Also, the coagulant could be reduced by 50%. For Fenton oxidation process, stepwise addition of reagents gave a 5% higher COD removal, and a 25% reduction in chemical consumption.

Hamidi Abdul Aziz, Mohd SuffianYusoff, Mohd Nordin, Adlan Nurul Hidayah, Adnan Salina Alias – Malaysia (October 2003), Title : Physico-chemical removal of iron from semi-aerobic landfill leachate by limestone filter.

Limestone has been proven effective in removing metals from water and wastewater. A literature review indicated that limestone is capable of removing heavy metals such as Cu, Zn, Cd, Pb, Ni, Cr, Fe and Mn are through a batch process or by filtration technique. The removal capability is reported at up to 90%. The present study attempts to investigate the suitability of limestone to attenuate total iron (Fe) from semi aerobic leachate at Pulau Burung Landfill Site in Penang, Malaysia. Iron was found in significant quantities at the landfill site. The study also aims to establish the Fe isotherm and breakthrough time of the proposed limestone filter for post-treatment to the migrating landfill leachate before its release to the environment. The limestone media used in the experiment contain more than 90% CaCO3 with particle sizes ranging from 2 to 4 mm. Four filter columns (each 150 mm in diameter and 1000 mm depth) were installed at the landfill site. Metal loadings were kept below 0.5 kg /m3 day and the experiment was run continuously for 30 days. Initial results indicated that 90% of Fe can be removed from the leachate based on retention time of 57.8 min and surface loading of 12.2 m3/m2 day. For the batch study on the Fe isotherm, the results indicated that limestone is potentially useful as an alternative leachate treatment system at a relatively low cost.

Shuokr Qarani, Aziz Hamidi, Abdul Aziz, Mohd Suffian Yusoff, Mohammed J.K.Bashir – Malaysia (may 2011), Title : Landfill leachate treatment using powdered activated carbon augmented sequencing batch reactor (SBR) process: Optimization by response surface methodology.

In this study, landfill leachate was treated by using the sequencing batch reactor (SBR) process. Two types of the SBR, namely non-powdered activated carbon and powdered activated carbon (PAC-SBR) were used. The influence of aeration rate and contact time on SBR and PAC-SBR performances was investigated. Removal efficiencies of chemical oxygen demand (COD), colour, ammoniacal nitrogen (NH3-N), total dissolved salts (TDS), and sludge volume index (SVI) were monitored throughout the experiments. Response surface methodology (RSM) was applied for experimental design, analysis and optimization. Based on the results, the PAC-SBR displayed superior performance in term of removal efficiencies when compared to SBR. At the optimum conditions of aeration rate of 1 L/min and contact time of 5.5 h the PAC-SBR achieved 64.1%, 71.2%, 81.4%, and 1.33% removal of COD, colour, NH3-N, and TDS, respectively. The SVI value of PAC-SBR was 122.2 mL/g at optimum conditions.

Shrawan K.Singh, Walter Z.Tang – U.S.A (January 2013), Title : Statistical analysis of optimum Fenton oxidation conditions for landfill leachate treatment

Optimal operating conditions observed by peer reviewed publications for Fenton oxidation of raw and biological and coagulation treated leachates were reviewed and statistically analyzed. For the first-stage Fenton oxidation, the optimal pH range of 2.5–4.5 was observed for raw and coagulation treated leachates with a median pH of 3.0, whereas, for biologically treated leachate the optimum pH range was 2.5–6.0 with a median pH of 4.2. Theoretically, the optimal ratio of H2O2/Fe2+ should be the ratio of rate constants of the reactions between $OH_{\bullet}$ radical with Fe2+ and H2O2, which is approximately 11; however, for leachate treatment, a median optimum relative dose of 1.8 (w/w) (3.0 M/M) was observed. Biologically treated leachate showed relatively lower optimum ratio of H2O2/Fe2+ doses (median: 0.9

w/w) as compared to raw (median: 2.4 w/w) and coagulation treated (median: 2.8 w/w) leachate. Median absolute doses of H2O2 and Fe2+ were 1.2 mg H2O2/mg of initial COD (COD0) and 0.9 mg Fe2+/mg COD0, respectively and raw leachate required higher reagent doses compared to pretreated leachates.

A.AnfrunsJ.Gabarró,R.Gonzalez-Olmos, S.Puig M.D. BalaguerJ. Colprim -Spain (August 2013), Title : Coupling anammox and advanced oxidation-based technologies for mature landfill leachate treatment

The aim of this study was to evaluate the suitability to couple anammox process with advanced oxidation processes (AOPs) to treat mature landfill leachate with high nitrogen and non-biodegradable organic matter concentrations (2309 ± 96 mg N–TN L−1 and 6200 ± 566 mg COD L−1). The combination of a partial nitration-anammox system coupled with two AOP-based technologies (coagulation/flocculation + ozonation and photo-Fenton) was assessed in terms of nitrogen and carbon removal. Total nitrogen removal efficiency within a range of 87–89% was obtained with both configurations without the need of any external carbon source. The COD removal efficiencies attained were 91% with coagulation /flocculation + ozonation and 98% with photo-Fenton. Applying the biological treatment prior to advanced oxidation processes- based technologies reduced the quantity of needed reagents giving attaining higher removal efficiencies. From a basic economical point of view and taking into account the results of this study, the combination of partial nitration–anammox system with photo-Fenton treatment was more favorable than with coagulation/flocculation + ozonation treatment.

Míriam Cristina Santos Amaral,Wagner Guadagnin Moravia,Liséte Celina Lange,Mariana Moreira Zico Roberto,Natalie Cristine Magalhães &Túlio Luís dos Santos Brazil (November 2013), Title : Nanofiltration as post-treatment of MBR treating landfill leachate

Landfill leachate management has been a major environmental, economic, and social concern, and its treatment brings forth a challenge, especially regarding the high concentration of refractory organic matter, ammonia, and toxic compounds, which may vary considerably depending on the maturity, age, and biochemical reactions occurring in the landfill, besides the high variation on the volume generated. This study was aimed to investigate NF use as a post-treatment of landfill leachate that has been treated by membrane bioreactor (MBR). The experimental setup consisted of pilot plant comprised by an air stripping reactor, plus MBR and NF membranes. The pilot plant has a treatment capacity of 3 m3/d. The system has shown excellent leachate treatment performance, especially regarding the removal of chemical oxygen demand (80–96%), ammonia (85–95%), color (98–99.9%), and phosphorus (78–99.8%). The results have also shown the importance of NF to improve the effluent condition, and to produce treated effluents free of chemical substances and sludge. The membrane fouling was imputed to the adsorption of a humic substance on the membrane surface and the pore-blocking phenomena. By this route, treated landfill leachate may be reused at the landfill as water for dust arrestment, and also as earth work on construction sites.

3. CONCLUSIONS

Based on the literature, the following conclusions were drawn:

- The objective of this project was to investigate landfill leachate treatment technologies suitable under different conditions.
- Leachate treatment technologies exhibit variable removal efficiencies for organic and inorganic contaminants. The concentration and types of contaminants in leachate are determined by a number of factors, including the age of the landfill.
- Biological treatment methods showed better performance when removing organic contaminants, whereas physicochemical treatment methods were more suitable for the removal of inorganic contaminants such as heavy metal. There were a few treatment technologies that were efficient in most circumstances, but required a trade-off with treatment cost.
- In addition to contaminant removal efficiency and cost, other factors such as on-site/off-site facility, need for leachate storage, required area, and local water standards must be considered to find the appropriate treatment method.

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