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Abstracts

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USO DE ALAGADO CONSTRUÍDO (WETLAND) NO CONDICIONAMENTO DE EFLUENTE DE LAGOA DE ESTABILIZAÇÃO PARA FINS DE REÚSO NA AGRICULTURA NO SEMI-ÁRIDO BRASILEIRO

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The Brazilian semi-arid stretches for an area that covers the largest part of all Northeast Region States (89.5%). The semi-arid climate, characterized by a low annual rainfall of 400 to 600 mm during the months of January through April, prevails in approximately 60% of the State of Rio Grande do Norte. The characteristics of the region, such as scarce and uneven rainfall, shallow soils, temporary rivers and sparse vegetation, along with the type of land occupation, have resulted in precarious living conditions for the majority of its inhabitants. The planned reuse of domestic wastewater in agriculture has been indicated as a measure to mitigate the lack of water resources in the semi-arid and is being considered as an alternative to the farmers, specifically to those located around the cities. This paper presents the results of the evaluation of a constructed wetland used for conditioning the effluents of a primary facultative pond in Parelhas, State of Rio Grande do Norte – Brazil, aiming at their reuse in fertirrigation. Full and pilot-scale studies have shown that constructed wetlands have good capacity of reducing carbonaceous matter, suspended solids, nitrogen, phosphorus and pathogenic organisms. This reduction is accomplished by several mechanisms such as: sedimentation, filtration, precipitation and chemical adsorption, microbial and vegetal interactions, and complexation. The remaining concentrations of organic matter and nutrients were analyzed. It was verified average COD and SS removals of 73% and 85%, respectively. As for the hygienic quality, it was found that undesirable concentrations of thermotolerant coliforms were present in the final effluent during the whole period. The system presented concentrations higher than 10⁵ CF/100mL in the effluent. Helminth eggs were not found in the effluent, which confirmed the efficiency of the system in removing these parasites. Due to the low hygienic quality in this particular case, the wetland effluents could only be used in restricted irrigation, because they presented thermotolerant coliform concentrations higher than 2 log units in relation to the standard established by the WHO (1989) for use in unrestricted irrigation, that is, 10³ CF/100 mL.

TRATAMIENTO DE LODOS FECALES MEDIANTE WETLANDS ARTIFICIALES

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During the years 2003-2004 physicochemical, bacteriological and parasitological analyses were done for the characterization of the sludge transported by trucks, and the impact of its discharge into the sewerage system of Curuzú Cuatiá was evaluated. The results show that these effluents

do not fulfill with the limits of BOD₅, settleable solids and sulfides established for discharge in the sewerage system. The discharge of sludge produces instantaneous organic and solids overload in the treatment plant (stabilization ponds). Annually around 640m³ of settleable solids are discharged in the primary ponds, which represents 2% of their volume. The practice was continued for the purpose of evaluating alternatives for the treatment of the sludge. In this paper results of experiences that were carried out are stated: a) a pilot plant – wetland, artificial/drying bed cultivated with plants of the species *Typhas augustifolia*; b) in reactors (with and without macrophytes) for the treatment of the liquid effluent (leachate) of the same and c) the physical chemical, bacteriological and parasitological characterization of the dried sludge in the wetland. Based on the results a design of a modular plant was prepared for the treatment of 50 m³ sludge/day (formed by two artificial wetlands of 172 m² and a system of two stabilization ponds in series for the treatment of the liquid leachate (the wetland effluent)).

DEPURACIÓN DEL EFLUENTE DE UNA EMPRESA METALÚRGICA UTILIZANDO UN WETLAND CONSTRUIDO

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Wetlands have proven to be highly efficient in the removal of pollutants: they are of low-cost construction and maintenance, operated by unskilled labor and integrated within the environment. The objective of this paper is to evaluate the efficiency of a wetland constructed for the treatment of an industrial effluent (a metallurgical industry). Its dimensions is 50 m length by 40 m width, and depth of 80 cm, with a central partition so that the length-width relation is 5:1. Its bottom is bentonite sealed, and the plants are rooted on a layer of 1 m of soil. The macrophytes used are from the area of the Río Paraná Medio: *Eichhornia crassipes* (water hyacinth), *Typha domingensis* (totora), and *Pontederia cordata* (aguape), among others. The treatment efficiency was calculated taking into account the influent and the effluent of the wetland. P, CR, N and Zn were analyzed in sediments and plants. The sampling was carried out during 2 years. The wetland efficiently diminished the average concentrations and the variability of the parameters analyzed, except in the case of phosphate and ammonium. The average removals were 86% for CR, 70% for nitrate, 60% for nitrite, 78% for COD, 77% for BOD. The metal concentration significantly did not increase in the in-depth sediment after 2 years of operation. An increase in the concentration of metals and nutrients in the tissues of the macrophytes, as well as the increase of the biomass, represented the principal mechanism of removal of pollutants. The advantage of the macrophytes is the possibility of being harvested, which leads at important removal rates in short time. 80% of the surface of the wetland was covered with *Eichhornia crassipes*, which probably contributed to the oxygen reduction in water. Decreasing the level of water would help to favor the dominance of the rooted macrophytes and to increase the oxygen concentration in water. The quality of the effluent improved.

REMOÇÃO DE NUTRIENTES EM SISTEMAS DE LODO ATIVADO RECEBENDO ESGOTO PRÉ-TRATADO EM REATOR UASB

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Pedro Alem Sobrinho

This paper presents and discusses operational results of a pilot UASB reactor followed by an activated sludge unit for domestic wastewater, aiming the removal of nitrogen and phosphorus. Four experiments were run, maintaining the sludge age of approximately 10 days in all the experimental stages. In order to evaluate the phosphorus removal 4 experiments were carried out with the following operational conditions: STAGE 1) without addition of coagulant or polymer; STAGE 2) addition of ferric chloride (80 mg FeCl₃/L), without polymer addition; STAGE 3) addition of ferric chloride (80 mg FeCl₃/L), and of 1mg/L cationic polymer; and STAGE 4) addition of ferric chloride (150 mg FeCl₃/L), without polymer addition. The following conclusions were obtained: A) The activated sludge process, treating the effluent of an UASB reactor, is not efficient for nitrogen removal, due to the low amount of organic matter, needed by the organisms that carry out to denitrification; B) As far as ammonia removal is concerned, the activated sludge process is effective, as average removal efficiencies above 95% were reached; C) The use of ferric chloride for the physical-chemical removal of phosphorus was shown effective only for high relations Fe/Total P. Fe/Total P average relations ranged from 2.0 to 5.6 in the operational stages. With Fe/Total P relations from 1.5 to 2.1:1 and 2.3 to 2,8:1 the expected phosphorus removals in the order of 85% and 95%, respectively, did not occur. The average efficiencies of total phosphorus removal varied from 63 to 94% in the operational stages; D) The average relations of MLVSS/MLSS varied from 0.7 to 0.5 in the operational stages; the reduction of this relation is due to the generation of "chemical sludge"; and E) The system was shown efficient for the removal of organic matter. The average efficiencies of organic matter removal varied from 73 to 87% for total COD, in the operational stages.

REATOR UASB TRATANDO ESGOTO SANITÁRIO E DIGERINDO LODO AERÓBIO EXCEDENTE

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This paper discusses the performance of an upflow anaerobic sludge blanket reactor (UASB) treating sanitary wastewater and digesting excess sludge from an aerobic activated sludge unit. The research equipment consisted of two UASB reactors, both of plastic material reinforced with fiberglass, 407 liters each, and a post-treatment system – an activated sludge unit. They were located at the Technological Hydraulics Center of the University of São Paulo. This experiment was run in three different phases: (1) Start-up of the UASB 1 and of the UASB 2 (day 0 to day

194), (2) Normal operation of the UASB 1 and of the UASB 2 (day 195 to day 412); and (3) Return of the excess secondary sludge from the activated sludge unit to the UASB 2 (day 413 to day 527). The wastewater flow was 50 L/h, HDT 8 hours, and the average flow of the return aerobic excess sludge was 24 L/d. The following average concentrations were measured for the effluent of UASB 2 in the Phase 3: 198 - 158 mg/L (Total COD), 46 - 18 mg/L (Total BOD), 48 - 19 mg/L (TSS). In the same period, with the same flow, and the same HDT, UASB 1 presented the following effluent average concentrations: 234 - 157 mg/L (Total COD), 67 - 1 mg/L (Total BOD), 72 - 67 mg/L (TSS). According to such results, it can be concluded that UASB 2 was efficient to reduce the incoming organic matter, and maintained the treatment efficiency, its performance not being negatively affected when the excess aerobic secondary sludge was diverted to the UASB reactor.

ACLIMATACIÓN DE UN INÓCULO SULFATO REDUCTOR PARA LA ELIMINACIÓN DE SULFATOS EN UN REACTOR DISCONTINUO ANAEROBIO

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Many industrial effluents contain high concentrations of sulphates and organic matter. The anaerobic treatment of this type of wastewater generates hydrogen sulfide or hydrosulfuric acid, which at certain concentrations is toxic for methanogenic bacteria. An alternative treatment of this type of effluent is the metabolic way of sulfate reduction; however, one limiting factor is the availability of seeding material with enough metabolic activity to reduce high sulfate concentrations. This study obtained a sulfate-reducing biomass from the anaerobic granular sludge of a batch reactor, which can be used as seeding material for the treatment of effluents contaminated with high sulfate concentrations. The reactor was operated with a synthetic effluent made up of lactate and sulfates at a COD/sulfate stoichiometric rate of 0.67 and a pH of 7.5. The test was carried out with sulfate concentrations of 2.5 g SO₄²⁻/L and a strategy of adaptation of fixed efficiency. The findings show that it is possible to increase the metabolic activity of the sulfate-reducing bacteria, which will result in a sulfate-reducing seeding material with a sulfate elimination efficiency of 70% and a sulfate removal rate of 3.2 g SO₄²⁻/L-d in 25 days. This result indicates that it is possible to reduce the start-up time of anaerobic reactors for treatment of effluents with high sulfate concentrations. It was also proved that the anaerobic granular sludge is a suitable source of sulfate-reducing seeding material, due to its contents of sulfate-reducing bacteria.

TRATAMIENTO DE AGUA RESIDUAL MUNICIPAL MEDIANTE UN BIORREACTOR ANAEROBIO DE MEMBRANA A ESCALA PILOTO

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This research carried out studies in a membrane anaerobic reactor in a pilot-scale. The UASB reactor coupled with ultrafiltration membranes was operated uninterruptedly to take advantage of the benefits of the anaerobic mean, and associate them with an effective retention of suspended solids, colloids, pathogenic microorganisms and parasites. The operating conditions in the biological area of this system (HRT = 6 h) produced an effluent that when combined with the operating conditions in the filtration area ($v = 2.25$ m/s, TMP = 20 psi) could minimize the frequency of chemical cleaning (sodium hypochlorite solution at 300 mg/l) and delay the irreversible fouling. The system accomplished a removal of 87.62% of total COD (83% of soluble COD), 99.7% of suspended solids (SS) and 100% of fecal coliforms and helminth eggs. Preliminary analyses carried out in the material accumulated in the membrane confirmed that this material is essentially made up of extracellular organic substances.

REMOÇÃO BIOLÓGICA DE NITROGÊNIO VIA NITRITO UTILIZANDO FENOL COMO FONTE DE CARBONO

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The present survey studied the transformation of ammonia nitrogen directly to nitrate, using phenol as source of carbon in the anoxic stage. A pilot sequential biological reactor was operated (volume of 20 liters), fed with 5.0 liters of synthetic wastewater. The research was characterized by a gradual increase of the concentration of ammonia nitrogen (200, 300 and 500 mgN-NH₃/L) in the affluent, and an effort to find operational conditions for the predominance and prevalence of the nitrite at the end of the aerobic phase. Phenol (1,000 mg/L) was used as the only source of carbon by the heterotrophic microorganisms for reduction of the nitrogen oxidized during the anoxic phase. Predominance of nitrite was observed at the end of the aerobic phase throughout the experiment. At the aerobic phase the pH was controlled close to 8.3; the temperature ranged between 25 and 33°C, and the dissolved oxygen concentration was maintained next to 1.0 mgO₂/L. The efficiency of removal of N-NH₃ was over 93%; the relation N-NO₂ / (N-NO₂ + N-NO₃) ranged between 88 and 97%. The specific nitrification rate ranged between 0.04 and 0.06 kg N-NH₃ / kg VSS.day for a concentration of VSS in the range of 2,175 to 2,645 mg/L. Phenol was adequate as a source of carbon for concentrations of 200 to 300 mgN-NH₃/L. The rate of "specific denitrification" ranged between 0.018 and 0.049 kg N-NO₂/ kg VSS.day. The F/M ratio remained in the range of 0.05 to 0.09 kg Phenol/kg VSS.day. For concentrations of N-NO₂ in the reactor over 75 mg/L, the experiment using phenol as the only source of carbon was severely inhibited.

DETERMINACIÓN DE LA VELOCIDAD DEL FLUIDO EN LAS LAGUNAS DE MADURACIÓN DE LIDSEY

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The present study was carried out in the municipal treatment plant of Lidsey located in Bognor Regis at the South of England. The tertiary treatment of such plant consists of three (3) parallel maturation ponds (North, Plant and South), with similar dimensions (122mx14mx1m). The South pond has three baffles, deferring its geometry with respect to the other two ponds. This research was developed in the tertiary treatment phase, and its goal was to study the movements caused by the viscosity of Eddy, dead spaces, short circuits, and the velocity of the fluid in different depths (surface, depth P = 25, 45, 60 cm, measured from the surface toward the bottom of the lake). In order to measure the velocity on the surface, floatable pieces of similar size and weight were used, with a degree of submergence around 98% (therefore the effect of the wind on the such pieces was avoided). The flow velocity under the water level was determined with dopes constructed in the laboratory and calibrated to the depth required before its use. In addition, a simultaneous experiment with floating objects and WT Rhodamine was carried out. Thus, the trajectory of the movement of the fluid was observed with each instrument, being concluded that both should be used, in order to obtain the desired data and know the effect of the wind on the fluid. The best hydraulic behavior was achieved by the pond with baffles, with the lowest effect of the viscosity of Eddy and the greatest time for the exit of the flow jet, in comparison with the original pond. In all the ponds the highest velocity was measured on the surface, and a zero velocity in the depth of 60 cm. The hydraulic patterns of the baffled pond was predicted using the HYDRO-3d model, resulting in similar forecasts to the experimental values, with regard to changes of velocity of the fluid (short circuits), areas with higher velocities and dead spaces.

ELIMINACIÓN BIOLÓGICA DE ALTAS CONCENTRACIONES DE FENOL PRESENTE EN AGUAS RESIDUALES

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Moreno-Andrade Iván

In chemical, pharmaceutical, and other industries, typical concentrations of phenols in the wastewater range between 35 and 400 mg/L. However, in extreme cases, as in some Mexican refineries, the concentration of phenols may be as high as 30,000 mg/L. In this paper the use of a control strategy is presented for the treatment of this type of effluent in discontinuous reactors. The optimal control strategy uses the measurement of the dissolved oxygen on line, and the volume in the reactor to control the flow of the influent, in such a way that the rate of degradation of the substrate fluctuates around its maximum value throughout the fill phase. The use of the optimal strategy in the degradation was evaluated, when one mixes municipal wastewater and phenol. In addition, the degradation of phenol concentration peaks was evaluated in the wastewater (700, 1500, 3000 and 7000 mg of phenol/L). The application of the optimal strategy showed that it is possible to treat a mix of wastewater and phenol. The optimal strategy showed

that is possible to treat in a single cycle, the different phenol concentration peaks in the municipal wastewater.

DEGRADACIÓN BIOLÓGICA DE FENOL UTILIZANDO TÉCNICAS RESPIROMÉTRICAS

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Phenol is a common constituent of the wastewater, found in several industries. Even at low concentrations it is toxic, and for this reason efficient treatment methods are required, in order to reduce the phenol concentration in the wastewater to acceptable levels. In the province of Buenos Aires the limit of discharge in surface waters is as low as 0.5 mg/L. Of the many applicable existing methods for the degradation of phenol, biological treatment is especially recommended, as it has a great potential for transforming almost completely the phenolic components in innocuous end products. The objectives of the present investigation were to analyze the biological degradation of phenol, using a seeded and a non-seeded activated sludge process; and also, to obtain kinetic and stoichiometric parameters, by means of respirometry. Semi-continuous to lab scale reactors were used in the activated sludge process. In order to evaluate the effect of the phenol on the microbial growth a closed respirometer was used. The reactor was filled with sludge (seeded and non seeded), previously washed and buffered at pH 7, and phenol was added in such a way that concentrations between 20 and 4000 mg/L were achieved. Oxygen concentration was measured along time, so that a representative slope could be obtained in graph. In the case of the non acclimatized biomass it was observed that the phenol produces an effect of `inhibition` on the microorganisms at concentrations over 20mg/L. For the acclimatized biomass a faster rate of oxygen uptake was observed as well as an immediate increase in the efficiency of phenol reduction. The oxygen uptake was adjusted to the equation of Haldane, several kinetic constants being obtained.

SEPARAÇÃO SÓLIDO-LÍQUIDO EM EFLUENTES DA SUINOCULTURA COM USO DE EXTRATOS TANANTES MODIFICADOS E APLICAÇÃO DE MODELOS DE OTIMIZAÇÃO MULTIVARIADA

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Due to the high number of contamination sources found in swine effluents, its reuse or direct disposal in the water environment becomes unsustainable, being the levels of concentration and organic load particularly high. A treatment alternative is the use of solid-liquid separation techniques, with the utilization of organic, synthetic, or natural coagulants, aiming the reuse of the

waste produced and a decrease in the environmental impact, when compared with the utilization of inorganic coagulants. This work presents the experiments run for swine effluents treatment, using solid-liquid separation technique with utilization of a natural coagulant derived from the modified extract of the skin of Black Acacia (*Acacia mearnsii*) and sequential addition of Polyacrylamide (PAM) as coagulation aid. Turbidity removal efficiency was between 62.7 and 98.4%, and COD removal was 90%. The removal of metals was higher than 86%. The use of a coagulation aid (PAM) showed that an important reduction in sludge volume was achieved, but the same was not true for turbidity the removal.

TRATAMIENTO DE AGUAS DE LA DESALACIÓN DEL PETRÓLEO PARA SU APROVECHAMIENTO EN INYECCIÓN AL SUBSUELO

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In the process of crude oil desalinization, wastewater is produced (congenital waters). These waters can be used in the injection wells to the subsoil. In order to achieve this procedure, wastewater treatment is required. The objective of this study was to define and to develop the best treatment system for the congenital waters, so that an effluent with the required quality can be obtained for its utilization in the injection wells. The characterization of the congenital water indicated a high content of chlorides and of sodium, as well as an extremely high hardness (4,500-4,800 mg/L). Furthermore, the water contains bicarbonates, sulfides, and hydrocarbons (COD of 2,500-2,900 mg/L). The treatability study was conducted in two stages: train tests in laboratory and physical simulation in pilot plant. In laboratory the feasibility of different processes and of its combinations was studied: precipitation-coagulation and sedimentation, chemical oxidation, filtration, adsorption, aeration, decarbonation, and ionic exchange. The best doses of the chemical reagents were determined, and selected on the basis of the effectiveness of the processes. The best materials for filtration and adsorption were identified, the parameters for the removal of bicarbonates, the capacities of the resins of anionic and cationic exchange. According to the results and the respective analysis, four trains of treatment were proposed. The evaluation and the comparative analysis of the trains indicated that the best treatment of the congenital waters for utilization in subsoil injection, turned out to be water softening (lime-sodium carbonate), followed by oxidation with peroxide, decarbonation and filtration.

PRÉ-TRATAMENTO DE EFLUENTES TÊXTEIS POR PROCESSOS OXIDATIVOS AVANÇADOS VISANDO MAIOR EFICIÊNCIA DO TRATAMENTO BIOLÓGICO POSTERIOR

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Textile industry effluents have low biodegradability (BOD/COD ratio). An alternative to treat these effluents comprises advanced oxidative processes (AOPs) characterized by the use of a strong oxidant, the hydroxyl radical ($\bullet\text{OH}$), to degrade organic matter. Photolysis and heterogeneous photolysis catalyzed by titanium dioxide are two processes that show great potential to treat textile industry effluents. Both processes receive the addition of hydrogen peroxide ($\text{H}_2\text{O}_2/\text{UV}$ and $\text{H}_2\text{O}_2/\text{TiO}_2/\text{UV}$). The complete treatment by AOPs is very expensive and, therefore, this work intended to assess a pretreatment by AOPs to increase the textile effluent biodegradability and improve its subsequent biological treatment. A preliminary test verified that the average oxidation state (relationship between COD and TOC) was stabilized and that the residual H_2O_2 was consumed after a two-hour reaction, being unnecessary to extend the treatment beyond this period. Treatments with 2 mM of $\text{H}_2\text{O}_2/\text{UV}$ and with only UV had few or no effect on the BOD, COD or biodegradability of the textile effluent. Treatments with 5 mM and 10mM of $\text{H}_2\text{O}_2/\text{UV}$ presented the same trend, with increase of the effluent biodegradability during the first 30 minutes of treatment, but the increase of biodegradability by mg of H_2O_2 consumed was higher at the dose of 5 mM of H_2O_2 than at 10 mM of H_2O_2 . COD removal in the treatments with $\text{H}_2\text{O}_2/\text{TiO}_2/\text{UV}$ was proportional to the increase of the peroxide dose applied, but the treatment with 5 mM of H_2O_2 provided an increased biodegradability (0.14 to 0.25), whereas the treatments with 0 e 2 mM of $\text{H}_2\text{O}_2/\text{TiO}_2/\text{UV}$ resulted in small BOD increases. Treatments with 5 mM of H_2O_2 with ($\text{H}_2\text{O}_2/\text{TiO}_2/\text{UV}$) and without ($\text{H}_2\text{O}_2/\text{UV}$) titanium dioxide were selected as the best among the AOPs assessed. Both treatments were efficient to remove color from the textile effluent, accomplishing 64 to 66% of color removal during the first 60 minutes of reaction. However, the presence of the catalyst TiO_2 did not result in higher effluent biodegradability. Based on these findings, the treatment $\text{H}_2\text{O}_2/\text{UV}$ with 5 mM of H_2O_2 and a 30-minute UV irradiation was considered the best alternative for the effluent studied.

INFLUENCIA DE CAMBIOS EN LA OPERACIÓN DE UN SISTEMA DE LODOS ACTIVADOS A ESCALA DE LABORATORIO SOBRE LA ESTRUCTURA BACTERIANA DETERMINADA MEDIANTE TÉCNICAS MOLECULARES

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The activated sludge wastewater treatment is a complex, dynamic and heterogeneous biological system. Little is known about its biology because of the difficulty of growing microorganisms through conventional methodologies. It is estimated that approximately 85 to 99% of the components that make up bacterial communities in activated sludge have not been grown or identified. During the last years, the advent of molecular techniques such as the polymerase chain reaction (PCR) has promoted the development of several methods that allowed researchers to obtain information on the genetic diversity of the microorganisms and eliminate the need to grow them for identification. These methodologies have been very important to learn about the profusion and abundance of the different biotypes present in environmental samples. This work submits the results of the use of the t-RFLP technique with the 16S rRNA gene as a genetic marker, applied to a laboratory-scale activated sludge system for the detection and prediction of operational problems, especially in the separation of the liquid effluent and in the compaction of solids. Two reactors were designed with their respective sludge sedimentation tanks. Operation tests were carried out under different conditions to determine physical and chemical parameters and a t-RFLP analysis was also conducted. The results indicated that the reduction of DO induces bulking. The t-RFLP electropherograms confirmed that the fragment of 196 pb was a representative of bulking. During the reduction in the F/M rate (0.3 to 0.1), the electropherograms showed an increment of the fragment of 33 pb associated with bulking. Experiments are being developed on the variation of the cell retention time in the reactor, its influence in the process efficiency and in the changes of the bacterial diversity. Considering that the fragments of 196 pb and 33 pb coincidentally increased their relative frequency in the days before the detection of bulking by physicochemical parameters, the studies will continue to verify whether these fragments or other fragments that may appear can be used to predict operational problems.

REMOÇÃO DE COLIFORMES TOTAIS E E. coli EM LAGOAS DE POLIMENTO: PRODUÇÃO DE EFLUENTES ADEQUADOS À UTILIZAÇÃO EM IRRIGAÇÃO E PISCICULTURA

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The World Health Organization (WHO) has recently changed his criteria for the utilization of sanitary wastewater in irrigation and fish farming. The criteria previously expressed as control of thermotolerant (fecal) coliforms, became described as control of E.coli. However, recognizing situations in which analytical or financial constraints can impose restrictions on the determination of E.coli, it remains valid to evaluate the possibility of, alternatively, monitor the pond effluent as total coliforms. This study confirms the high capacity of a polishing pond in producing an effluent with excellent microbiological quality, in a system of ponds in series/maturation pond. According to a planned monitoring program, during almost four years, an experimental system of ponds was controlled. As a result, a much similar trend between the decay of total coliforms and E.coli was found, and a difference, perceptibly consistent, of one logarithmic order (1 log₁₀) between them. It is suggested, therefore, that the recommendation of WHO, expressing the limit of E.coli/ 100 mL, would be equally satisfied if Total Coliforms/ 100 mL were used, one logarithmic order (1 log₁₀) being considered as a difference.

GERENCIAMENTO DO LODO EM UM SISTEMA UASB + BF

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This paper presents and discusses the results of one year monitoring of a system consisting of an UASB reactor followed by an aerated submerged filter, as well as the management of the sludge produced in such units. The main operational rules were related to sludge disposal in the UASB, and to the biofilter frequency of backwashing. The UASB reactor achieved an average efficiency of BOD and COD removal of 85% and 81%, followed by an additional removal in the biofilter close to 30% (BOD) and 20% (COD). The coefficient of biomass production (Y) in the UASB was found to be 0.69 kgTSS/ kg COD and 0.20 kg VSS/kg COD. A routine of sludge disposal could be established as 2.4 m³ (volume of the drying bed) every 4 to 7 days, besides a frequency of filter backwashing every two days. The sludge management included the hygienization (with lime), under different mixing conditions (30, 40 and 50%). A "Class A" sludge was produced after a lime dosage of 50%, 40 days of storage after lime addition, satisfying the Brazilian legislation.

MODELACIÓN OPERACIONAL DE DIGESTORES EN PLANTA DE TRATAMIENTO DE AGUAS SERVIDAS

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The objective of this paper is the development of a mathematical model of anaerobic digestion that simulates the principal control variables in the process, and helps the planning and operational phases in normal and particular situations of operation in the 15,000 m³ digesters of La Farfana WWTP, in Santiago, Chile. This work was carried out jointly by the engineers of La Farfana and the School of Biochemical Engineering of the Pontifical Catholic University of Valparaiso, Chile. The model, called AM3, corresponds to a three stage process: hydrolysis, acidogenesis and methanogenesis, the action of external inhibiting agents being considered. The calibration process was carried out using available operational data of the plant, with support from laboratory experiments. The results made it possible to represent satisfactorily and reliably the process of digestion within the plant anaerobic reactors, simulating the patterns of the principal control variables of the process during normal and particular periods of operation, the latter using an inhibiting factor of continuous adjustment, turning out in this way a highly flexible tool to variable conditions. Finally, the reliability of the model allows its use in industrial processes, as a tool for operational support of processes within a treatment plant. It helps to take operational decisions, being possible to improve the knowledge and application of this type of model.

TRATAMIENTO DE AGUA RESIDUAL MUNICIPAL CON BIO-REACTORES UASB DE MEMBRANA: EFECTIVIDAD Y TAPONAMIENTO

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This research assessed the effect of the cellular retention time (CRT) on the removal of contaminants in a laboratory-scale facility, made up of two UASB bioreactors coupled with membranes. The study determined physicochemical, hydraulic and biological parameters and it was found that the effluent complies with the Mexican legislation for water reuse.

The fouling phenomenon was studied in both ultrafiltration modules, and it was verified that the two-phase mechanism that is typical in filtration tests was periodically repeated, that is, there were successive events in which the flow presented an initial exponential decrease followed by a phase in which it was relatively constant during the long-time operation of the system under study. According to the theory, each stationary phase is associated with the development of a biofilm, and due to this reason the discussion is focused on the overlapping of biofilms. Similarly,

the autopsy of the clogged membranes was carried out including the determination of the biomaterial ultrastructure by electron microscopy, microanalysis of the surfaces by energy dispersion spectroscopy (EDS) and calculations of the microbial populations through the isolation of DNA associated with the biofilms.

The data obtained suggest that the biomaterial is made up of overlapped layers of semipermeable biofilms, in which organic and inorganic compounds are mixed within the matrix that makes them up. The tridimensional organization, the presence of inorganic elements with a poor solubility (Ca, Mg), the existence of microorganisms in the innards of the biofilm and, therefore, the presence of their metabolites that work as building blocks, and the prevailing microenvironmental conditions inside the tubular membrane, justified the proposal that the mechanism that makes up each biofilm could be related to the biologically induced mineralization theory. Thus, final discussion of this work is focused on the mechanical and cohesive properties of the biomaterial generated in each membrane.

GENERACIÓN DE LODOS Y EVOLUCIÓN DE LA BIOMASA DE UN REACTOR UASB A ESCALA REAL TRATANDO EFLUENTE DE MALTERÍA

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Constanza Boix
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The change of an old Imhoff tank into an UASB reactor to treat brewery effluent was carried out based on the results of a pilot-scale test, and a technical and economic feasibility study. The reactor was inoculated with sludge from an anaerobic treatment pond for meat packing plant effluents, which adapted easily and caused no inconveniences related to its original grease contents. The complete load was achieved in just nine weeks, with a soluble COD removal of approximately 80%. The evolution of the sludge blanket was monitored, including the determination of total and volatile solids content, and the profiles of the solids concentrations at different heights in the whole reactor. The original sludge immediately formed small granules with an average size of 0.7 to 0.85 mm. The loads around 0.2 kg COD/kg VSS.d achieved at the start-up were relatively low, due to the high amount of a totally expanded sludge, with concentrations between 40 and 50 g TSS/L and 85% of VSS. A value of $Y = 0.09$ g VSS/g CODrem was obtained for the cellular yield coefficient.

DESARROLLO DE SOLUCIONES MODULARES TRANSPORTABLES PARA LA POTABILIZACIÓN DE AGUA Y TRATAMIENTO DE EFLUENTES CON USO DE TECNOLOGÍAS AVANZADAS

Francisco Gross
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Ana Laura Pereyra
Alberto Bracho

This work presents the strategy for the development of solutions for drinking water as well as wastewater treatment, using prefabricated modular and compact units. Advanced technologies were taken into account, looking for cost-efficient and competitive technical solutions, applicable to populations from 25 to 100,000 inhabitants and/or industries. Such strategy is based on the development of volume-intensive designs, with application of advanced technologies, using skilled materials that optimize the durability-cost relation of each solution. It is pointed out that the use of dissolved air flotation (DAF) is highly efficient for solids and organic matter removal, and that it presents the least area requirement when compared with a typical sedimentation process. It is shown that plastic strengthened with fiberglass is an alternative material to stainless steel for the construction of treatment plants. Its price is 25% lower than that of AISI 304, the weight of the unit is 75% lower, higher resistance and durability of the material is expected. Based on design models, common schemes and design of the following solutions were developed: modular Drinking Water treatment plant (FBD), with DAF technology, developed for flows from 10 to 650 m³/h (1,600 to 104,000 inhabitants); Wastewater Treatment Plant (ETE) using septic tanks and biological filtration (FSFB), serving populations smaller than the 200 people; Wastewater Treatment Plant using the activated sludge process and aerobic digestion (LADA), for populations between 250 and 2,000 inhabitants; Wastewater Treatment Plant using biological filtration and DAF technology (FB-DAF), developed for populations between 2,000 and 80,000 inhabitants; Wastewater Treatment Plant using Physical Chemical process (UTFQ) and dissolved air flotation (DAF), developed basically for the industrial area; both for effluent reuse, and recovery of raw material, and for the improvement of existing treatment plants that operate overloaded.

CRITERIOS DE DISEÑO PARA LAGUNAS DE EFLUENTES DE TAMBOS EN CONDICIONES NACIONALES

Soledad Gutiérrez
Noel Cabrera

The concept of “best applicable technology” has been adopted as the basic guidance criterion for the development of dairy farm effluent treatment. Systems of pond in series (an anaerobic pond followed by a facultative pond) have been widely used in milk-producing countries, as New Zealand and Australia. Dozens of these systems have been built in Uruguay according to the designs of these first systems. However, the criteria were not adapted to the conditions of the national production. These passive systems were originally designed and built for domestic wastewater treatment. When they treat dairy farm effluents they achieve an important reduction of the organic load, but they do not meet the nitrogen, phosphorus and pathogen limits required by the legislation to discharge these effluents into water bodies. Significant differences between

domestic and dairy farm effluents such as the proportion of solids and the C:N:P ratio, and their concentrations, justify this inefficiency. This work intends to discuss the results obtained from pond systems designed according to domestic wastewater criteria or according to criteria imported from other countries, and to present design equations for this type of systems that are operated under the conditions of the national production.

TÉCNICA UASB APLICADA A LÍQUIDO RESIDUAL DOMÉSTICO EN URUGUAY: PLANTA PILOTO PANDO

Inés Fuentes

Administración de Obras Sanitarias of Uruguay (DARES), with technical assistance of SANEPAR (Paraná, Brazil) constructed in 1993-1994 two UASB reactors, both totally underground. One of them is an upgrade of an existing Imhoff tank, and the other is a RALF reactor. These reactors are located in the city of Pando, close to Montevideo, Uruguay, in an area of temperate climate. In this paper the operational history, the existing problems, and the operational results obtained in the different stages of operation are presented.

DISPOSICIÓN DE EFLUENTES DE TIJUANA – UNA SOLUCIÓN TRANSFRONTERIZA

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Marcos Bigatti
Hermila Tinoco Téllez
Toribio Cueva
Alejandro Capeluto

The United States Environmental Protection Agency (EPA), the North American Development Bank (NADB) and the Tijuana State Commission of Public Services (CESPT) carried out a conceptual study for the disposal of the city of Tijuana's treated wastewater generated at the Tijuana river basin. The study included the assessment of several alternatives for this disposal with the purpose of meeting the needs of the public human health and the environmental protection. The whole work was based on binational treaties and regulations due to the cross-border characteristics of the case in question.

The study included the selection of conveyance alternatives and final disposal sites, and a multicriteria analysis that addressed technical, economic and environmental aspects for the final assessment. This work relied on a decision-making tool for the adoption of the most convenient alternative.

TREATMENT OF HIGH SULFITE REFINERY WASTEWATER BY CONVENTIONAL ACTIVATED SLUDGE

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A clean fuels project at a U.S. refinery included the addition of a gasoline desulfurization unit that generates SO₂ offgas. The offgas will be scrubbed in a caustic scrubber before released to the atmosphere. The SO₂ will primarily be converted to Na₂SO₃ (sodium sulfite) and to a lesser extent to NaHSO₃ (sodium bisulfite) and NaSO₄ (sodium sulfate). The scrubber blowdown will require treatment to oxidize the sulfites to sulfate. Two options have been identified to treat the scrubber blowdown: (1) Oxidation in the Refinery's activated sludge wastewater treatment plant and (2) Oxidation in a new air oxidizing system. A preliminary evaluation of (1) indicated that the existing activated sludge system would be capable of treating the scrubber blowdown with minimal impact on its hydraulic and treatment capacity. However, there were some concerns regarding its implementation because of potential inhibitory effects, non-compliance with Whole Effluent Toxicity (WET) test, and incomplete oxidation of sulfites to sulfate in the activated sludge system. In order to address these concerns, a bench-scale simulation of the activated sludge system was operated for six weeks while being fed with wastewater from the Refinery. Results of the study are presented herein.

USO DE OZÔNIO PARA MELHORIA DO TRATAMENTO BIOLÓGICO DE EFLUENTES DA INDÚSTRIA DE CELULOSE

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Adair José Regazzi
Felipe Dutra Brandão
Jaqueline Almeida de Oliveira

The paper investigates the use of ozonization to remove recalcitrant compounds and improve the biotreatability of alkaline effluents of ECF bleaching of eucalyptus kraft pulp. These effluents have low biodegradability and ozonization promotes an improvement of this biodegradability, especially due to an increase in BOD₅ and a slight reduction of COD. The tests were carried out in two samples (Effluent A and Effluent B). The influence of pH (10.9 and 7) and temperature (35 and 70°C) parameters were evaluated in Effluent A, and the influence of hydrogen peroxide in ozonization (doses of 0.7, 2, 4 and 10 mM) was evaluated in Effluent B. The data were subjected to statistical analysis through multiple linear regression. A COD removal up to 20% with a combination of 20 mM of O₃, at a pH of 10.9 and a temperature of 70°C was noticed in Effluent A. Removals of COD, TOC, color and carbohydrates improved as the ozone dose was increased. There was a 92% increase in biodegradability (BOD₅/COD) with an ozone dose of 10 mM, at a pH of 10.9 and a temperature of 70°C. Acute toxicity dropped with the increase in the O₃ dose. There was a COD removal up to 21% with the combination of 20 mM of O₃ and 4 mM of H₂O₂ in Effluent B. The increase in the ozone dose affected more significantly the removals of COD, TOC and color than the increase in the H₂O₂ dose, where a slight influence of H₂O₂ was noticed for a same dose

of ozone. There was an increase in biodegradability up to 63% with an ozone dose of 10 mM and a H₂O₂ dose of 4 mM. Acute toxicity increased slightly with a higher dose of O₃ for doses of 2 and 4 mM of H₂O₂, but dropped subsequently, with the toxic effect being eliminated at 2 mM of O₃, regardless of the H₂O₂ dose. A slight TOC removal was noticed with a maximum value of 7% in 4 mM doses of H₂O₂ and 20 mM doses of O₃. The small TOC loss indicated that although the organic matter was being oxidized, which was indicated by the increase in the oxidation state and by the COD removal, it was not mineralized because mineralization should be attained by biological treatment rather than by chemical treatment, due to the lower costs of biological treatment.

DETERMINACIÓN DE LAS CONDICIONES DE OXIGENO DISUELTO DE UN SISTEMA DE LODOS ACTIVADOS QUE PERMITA LA PRODUCCIÓN DE LODOS FÁCILMENTE BIODEGRADABLES CON ALTO CONTENIDO DE PHB

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One of the problems of activated sludge systems is the great amount of sludge they produce, which is usually stabilized by anaerobic digestion and later disposed off in sanitary landfills. Different sludge pretreatment methods and operational variables have been tested with the purpose of accelerating its anaerobic digestion. It has been proved that energy storage compounds as polyhydroxybutyrates (PHB) are rapidly degraded in anaerobic reactors. If the balance in the conversion of the organic matter in the biological oxidation tank of activated sludge were controlled to promote the formation of biomass with high PHB content, it would be possible to accelerate the anaerobic digestion of the sludge generated, and to maintain high levels of organic matter removal.

This project studied the effect of three concentrations of dissolved oxygen (2 mg/L, 2.5 mg/L and 8 mg/L) on the accumulation of PHB in heterotrophic bacteria and the level of conversion of the organic matter in a laboratory-scale activated sludge system, fed by synthetic domestic wastewater, at an organic loading rate of 1 kg COD/m³-d at room temperature.

The findings indicated that the lower the dissolved oxygen concentration, the higher the PHB accumulation, resulting in a PHB content of 2.28 mg/g VSS at 2 mg/L of dissolved oxygen in the sludge and good COD removal efficiency.

REMOCIÓN DE NITRÓGENO EN AGUAS RESIDUALES A TRAVÉS DE LAS PLANTAS *Typha dominguensis* Y *Lemna* sp.

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The need to remove nutrients from wastewater to prevent harm to water bodies, has led to the search of new technologies that might provide this removal, and whose construction, operation and maintenance are appropriate to the environment. Constructed wetlands belong to these particular technologies, being the vegetation one of their basic components. Its role in the removal of nutrients has been questioned by some researchers, because their main action relies on nitrification/denitrification processes. This work intends to evaluate the removal of nitrogen in small-scale constructed wetland systems, using native plants such as *Typha dominguensis* and *Lemna* sp. The parameters NTK, N-NH₃, N-NO₂, N-NO₃, BOD and pH were measured weekly, during 4 months, in five different treatments prepared in triplicate: effluent or residual water (RW); residual water plus supporting material (WS); residual water plus supporting material plus the floating plant *Lemna* sp (L); residual water plus supporting material plus the emerging plant *Typha dominguensis* (T); and residual water plus supporting material plus *Typha dominguensis* (T), plus *Lemna* sp (LT). The results obtained favored the T and LT treatment for all the parameters studied (NTK, N-NH₃, N-NO₂, N-NO₃ and COD), whereas the RW and WS systems achieved a lower removal for all parameters than L and TL treatments. Problems of adaptation between microalgae and the *Lemna* sp did not allowed the development of the plant as expected, which caused the L treatment to achieve the lowest removal percentages for NTK and N-NH₃, showing an increment for N-NO₂. The results showed the role played by *Typha dominguensis* in the processes of nitrogen and organic matter removal, that occur inside the wetlands, and also confirmed the important activity carried out by bacteria and microalgae in the removal of nutrients from wastewater.

AVALIAÇÃO DE DESEMPENHO DE UM SISTEMA REATOR UASB - FILTRO BIOLÓGICO PERCOLADOR OPERANDO COM E SEM DECANTADOR SECUNDÁRIO

Patrícia Procópio Pontes
Carlos Augusto de Lemos Chernicharo

This paper intends to assess the influence of a secondary clarifier in the characteristics of an effluent generated by a treatment system that consisted of a UASB reactor followed by a trickling filter. A pilot-scale treatment system fed with sanitary sewage was used to perform the test. The results obtained in this work indicate that the treatment system operating with the secondary clarifier achieved a better performance and a higher compliance with the discharge parameters. It was found, however, that the trickling filter effluent showed very satisfactory levels of TSS, BOD and COD even before it flowed to the secondary clarifier. The results showed a very promising trend concerning the possible use of a UASB reactor/ trickling filter system without a secondary clarifier. In this particular operational configuration, the trickling filter effluent showed BOD, COD

and TSS average values of 43, 115 and 54 mg/L, respectively. The percentages of compliance with the discharge parameters for BOD and TSS (equal to 60 mg/l) were 85% and 75%, respectively

PÓS-TRATAMIENTO DE EFLUENTE DE TANQUE SÉPTICO POR BIOFILTRO AERADO SUBMERSO

Samuel Alves Barbosa
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Anaerobic reactors are sanitary sewage treatment units widely used in Brazil due to their low construction and operation costs, operational simplicity and low sludge production. However, these units do not provide the best effluent discharge conditions and most of the time these discharges do not comply with the Brazilian environmental legislation (CONAMA Resolution 357/05). This work studied a bench-scale Biological Aerated Filter (BAF) with useful volume of 6.3 liters, being operated as post-treatment of a 27 liter Septic Tank (ST) that treated synthetic sewage simulating domestic/sanitary sewage. The BAF was operated as the Septic Tank post-treatment unit in two phases during a 120 day-period. In the first phase the BAF received an average volumetric organic loading (VOL) of 1.05 kg COD/m³-day, for a surface loading rate (SLR) of 5.01 m³/m²-day, corresponding to a 4 hour hydraulic retention time (HRT). In the second phase the BAF received an average VOL of 1.97 kg COD/m³-day, for a SLR of 10.02 m³/m²-day, corresponding to a 2 hour HRT. During the monitoring phase, the removals of residual organic matter and solids present in the effluent of the Septic Tank unit were evaluated. In the first phase the BAF generated an effluent with average concentrations of COD, TOC and BOD of 46 ± 19 mg·l⁻¹, 13 ± 3 mg·l⁻¹ and 20 ± 9 mg·l⁻¹ and efficiencies of 80%, 87% and 78%, respectively. In the second phase these concentrations were 53 ± 10 mg·l⁻¹, 21 ± 5 mg·l⁻¹ and 21 ± 5 mg·l⁻¹ and efficiencies of 79%, 84% and 79%, respectively. As for SS and VSS, the reactor showed efficiencies of 62% and 68%, with an average concentration in the final effluent of 16.9 mg·l⁻¹ and 11.3 mg·l⁻¹ in the first phase. In the second phase the removal efficiencies of SS and VSS were 37% and 50%, with average concentrations in the final effluent of 18 mg·l⁻¹ and 9 mg·l⁻¹. Therefore, it is possible to affirm that the BAS unit, under the typical conditions of this study, can promote a suitable removal of the residual organic matter and of SS, thus assuring that the discharge of the sanitary effluent complies with the Brazilian environmental legislation.

EFEITOS DO RECEBIMENTO DE LODO GERADO EM ESTAÇÃO DE TRATAMENTO DE ÁGUA PARA ABASTECIMENTO EM SISTEMAS DE TRATAMENTO DE ESGOTO POR LAGOAS DE ESTABILIZAÇÃO

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The disposal of WTP wastes in water bodies may cause several problems to the aquatic environment. Alternatively, these wastes may be disposed in Wastewater Treatment Plants, being

hauled by trucks or discharged into collecting networks. This work assesses the impact of the discharge of these wastes in a Wastewater Treatment Plant located in the municipality of São Lourenço da Serra, State of São Paulo. The physicochemical and bacteriological variables of the raw sewage and of the effluent generated by anaerobic and facultative ponds were evaluated before and after the discharge of these wastes. During the two monitoring phases, the analyses of the results showed an excellent performance in the removal of organic matter, with DBO removal efficiencies of 90.5% in the first phase and 88.8% in the second phase. The nutrient removal efficiency (nitrogen and phosphorus) was within the design parameters. Despite the high results of pathogen removal observed during the first and second phases, the final effluent failed to comply with the values required by Decree 8468/76 and CONAMA Resolution 357/05. According to the experimental results, it was verified that the discharge of the WTP wastes did not change the physicochemical and biological characteristics of the raw sewage, nor interfered with the biological processes existing in this type of treatment, keeping the plant performance within the values estimated in its design. After bathymetric analyses in the anaerobic pond, it was noticed that both, in the first and second phases of the project, the average annual sludge accumulation rate was kept near 10 and 18 cm/year, respectively, values which are very close to those found through the empirical method proposed by Saqqar & Pescod (14.6 cm/year and 16.3 cm/year, respectively)

ESTUDIO CINÉTICO COMPARATIVO DE LA DEGRADACIÓN DE LA MATERIA ORGÁNICA EN UN SISTEMA LAGUNAR PROTOTIPO

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Hugo Eduardo Solís Correa
Edgar López Galván

An experimental aerobic stabilization pond with separation devices was built and operated alongside José Antonio Alzate Dam, fed by the waters of the Lerma River, located higher than 2,500 m above sea level, in the State of Mexico, Mexico. The pond was built with separation devices with the purpose of eliminating the hydraulic short-circuiting reported in the literature. After a detailed evaluation of each of the five channels that comprised the experimental pond, it was found that the degradation of the organic matter, reported as DBO₅, occurred in each of the channels as an independent unit. Three criteria applied to three researches that worked with constant rates of bacterial decay and dispersed flow were employed to determine the constant rate of degradation of organic matter using the results obtained under the actual operation conditions of the experimental pond. The behavior of the nitrogen cycle was assessed in the whole pond area and it was found a result equivalent to that reported in the literature for facultative ponds in service. The study calculated the treatment surface required to remove 83% of BOD in 20 m³/s, considered as Lema River's average flow under the geometric conditions of the experimental ponds, and obtained a treatment capacity of 11.72% of the total flow.

TRATAMIENTO ANAEROBIO DE AGUAS RESIDUALES URBANAS EN REACTORES DE UNA Y DOS FASES A BAJA TEMPERATURA

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Rolando Chamy Maggi
Paola Poirrier González

The anaerobic treatment of urban wastewaters (UWW) is carried out successfully in climates with temperatures higher than 20°C. However, at lower temperatures, there is an association of several factors that prevents a traditional system as the UASB reactor to remove organic matter satisfactorily. This research used a two-phase system in which the first reactor incremented the solubilization of the particulate organic matter (stirred tank type) and a second methanogenic reactor removed the dissolved organic matter (UASB reactor). The two-phase system can be compared with a traditional UASB reactor. The urban wastewater used presented a suspended solid fraction of 70% and a temperature ranging from 11 to 23°C. The two-phase system accomplished higher removals than the single-phase system, because the solubilization reactor at low temperatures was able to increment the initial soluble fraction from the hydrolysis of the suspended solids. Thus, the inflow into the two-phase UASB reactor was made up mostly of fermentation products and dissolved organic matter that could be efficiently degraded at low temperatures. Although there was a low concentration of biomass in the solubilization reactor, it was completely flocculent and had a hydrolytic activity that was increased during the operation time. On the other hand, the biomass in the two-phase UASB reactor maintained a granular characteristic with good hydrolytic and methanogenic activity. It is worth mentioning the intense acidogenic activity in this reactor and the high V_s of 0.9 m/h with which it operated without producing biomass washout. Conversely, the single-phase system could not operate with a V_s higher than 0.5 if the reactor was not washed, and although a high concentration biomass could be obtained, it was totally flocculent and presented low hydrolytic, acidogenic and methanogenic activity, which explains why this system was not able to stand organic overloads, nor remove organic matter satisfactorily in comparison with the two-phase system.

TRATAMENTO DE ÁGUA CINZA EM PROCESSOS (ANAERÓBIO + AERÓBIO) DE ALTA TAXA VISANDO O REÚSO PREDIAL

Bianca Barcellos Bazzarella
Ricardo Franci Gonçalves

One of the ways of saving water in households is the use of alternative supply sources. The reuse of gray waters for non-potable purposes, such as washing of cars, watering of gardens and flushing of toilets, is just an example. This study made a preliminary physicochemical and microbiological qualitative characterization of gray waters collected in several sources (lavatories, showers, kitchen sinks, washtubs and washing machines). Gray waters presented a significant concentration of fast biodegradable organic matter and sulphates, showing their great potential for producing H_2S , if stored without treatment. The nutrient concentrations (N and P) were lower than those found in the conventional wastewater, because the majority of them originate from excrements (urine and feces). The presence of *E. coli* showed the need of disinfection before reuse, especially

if reuse standards for flushing toilets are very stringent. Another phase studied the monitoring of a reuse system in a building located at the Federal University of the State of Espírito Santo. In this particular building two professors' offices are located, with women and men's individual and collective bathrooms, totaling six sinks, two showers, six toilets and two urinals. The building's gray waters (shower and lavatory's effluents) are sent separately to a Gray Water Treatment Plant (GWTP), whose process is based on the association of an Anaerobic Baffled Reactor (ABR), a Biological Aerated Filter (BAF), a Tertiary Filter (TF) and chlorine-based disinfection. The treatment adopted showed a high efficiency to remove turbidity, color, BOD₅, COD and E. coli and characteristics that are compatible with several established standards for non-potable reuse.

TRATAMENTO DE EFLUENTE DOMÉSTICO DE LODOS ATIVADOS POR MEMBRANA DE ULTRAFILTRAÇÃO

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Ivanildo Hespanhol
José Carlos Mierzwa

The treatment of municipal wastewater has been focused on the reduction of the environmental impacts produced by the disposal of these effluents into water bodies. Nowadays, however, due to the lack of water and degradation of water sources, the treatment of effluents is focused on the creation of sources for the reuse of water.

This work has the purpose of studying the treatment of municipal wastewater in a conventional biological activated sludge system followed by an ultrafiltration membrane system. A tubular ultrafiltration system was used with an average pore size of 0.05 μm and a membrane filtration area equivalent to 1.4 m^2 .

Filtration rates ranging from 20 to 24 $\text{L}\cdot\text{h}^{-1}\cdot\text{m}^{-2}$ were observed. This filtration rate may be considered relatively low if compared to other studies. A 14 to 17 $\text{L}\cdot\text{h}^{-1}\cdot\text{m}^{-2}\cdot\text{bar}^{-1}$ filtration rate relative to the pressure applied during the filter run was also observed.

The physicochemical characteristics observed in the filtrate were an absence of suspended solids and a COD in the composite sample of approximately 19 $\text{mg}\cdot\text{L}^{-1}$; an average pH of 6.99 ± 0.13 ; turbidity of 0.377 ± 0.13 NTU; and a conductivity of 698 ± 93 $\mu\text{S}\cdot\text{ohm}^{-1}$.

Thus, in comparison to other water standards it may be affirmed that in terms of quality the use of membrane treatment systems after biological systems is feasible and recommended. However, it is necessary to carry out research to minimize the membrane fouling phenomena.

EFEITO DA ADIÇÃO DE CLORETO FÉRRICO AO ESGOTO AFLUENTE A UM REATOR UASB

Ruy Scanho Marques de Queiroz
Sidney Seckler Ferreira Filho
Roque Passos Piveli

The discharge of effluents containing nitrogen and phosphorus compounds, even when previously treated, has been a source of problems to the water bodies from which this water is used for public supply. These compounds are nutritional for algae, causing blooms that produce toxins and result in higher treatment costs (application of activated carbon, pre-chlorination). Therefore, their removal has become as important as the reduction of the carbonaceous organic load. The upflow anaerobic sludge blanket reactors – UASB are a very compact type of treatment, with simple operation and monitoring procedures and, consequently, they present very competitive implementation and operation costs in comparison to other known processes. This study intends to assess the UASB capacity to remove phosphorous and organic matter with the injection of coagulants (ferric chloride, in this case) at the raw sewage inlet and through the sludge blanket. The purpose is to analyze COD and phosphorous removal in an actual UASB system that cannot be enlarged, located in an area of water sources. It is a simple and compact process with a relatively low sludge production, if compared to other aerobic processes. If an increase of the UASB treatment capacity with the simple addition of coagulants is found, this alternative may be an option to several systems that operate under similar conditions.

APLICACIÓN DE ELECTROCOAGULACIÓN PARA ELIMINACIÓN DE SILICIO EN AGUA DE ENFRIAMIENTO

Georgina Blass Amador
Luz Angélica Panamá Tirado.

Water supply for industrial use, despite its relatively small volume, became an important issue because of the intense competitiveness for water supply among users, and because of the quantity and diversity of contaminants it generates. Water for cooling towers used in thermoelectric plants amounts to the fairly low volume of 200 million m³. However, this sector begins to compete for water with other uses, especially in areas where the overexploitation of this resource is a major issue. Therefore, it is necessary to direct more efforts toward water treatment for reuse, taking into consideration the most suitable options in terms of cost and use of this water. The purpose of this work is within this present context. The study used electrocoagulation as an alternative technology to remove silica and other contaminants from the blowdown of cooling towers in a thermoelectric plant, and to prepare it for reuse through traditional chemical coagulation procedures. Chemical tests were carried out to determine the best iron doses that would be subsequently generated in the electrocoagulation cell. The iron doses were tested at the interval of 10 to 60 mg/L. A computer program was used to calculate the current necessary to generate iron in the cell to achieve the intended concentrations. The removal of silica obtained under different conditions showed that the simple addition of cationic polyelectrolyte in the effluent of the electrocoagulation cell reduces the silicon residual content in the water to levels that allow its recycling. This study concludes that considering the conditions under which the test

was carried out and the type of water, the process proposed is favorable and feasible because it does not require the addition of other reactive substance that would increase the its costs.

CARACTERIZACIÓN FÍSICO-QUÍMICA Y BIOLÓGICA EN LAGUNAS DE ESTABILIZACIÓN EXPERIMENTALES

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Icela Dagmar Barceló Quintal
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Anne-Laure Bussy Beaurain

The changes in time of physicochemical parameters and planktonic organisms were analyzed in secondary stabilization ponds that treated, in an experimental basis, municipal wastewaters with contribution from dairy industries from the Miahuatlán region, Veracruz, Mexico, in a system of facultative secondary batch reactors. Twenty one physicochemical parameters were determined and samples were collected for chlorophyll a and plankton analysis on a daily basis. Two phases were identified: 1) one anaerobic phase characterized by high biochemical and chemical oxygen demands, fecal coliforms and high ammonium concentrations; and 2) a subsequent aerobic phase in which all phase 1 parameters became very low, the acid pH became basic and high nitrate, phosphate and total phosphorus concentrations were found. The algae present belong to the classes Cyanophyceae, Chlorophyceae, Bacillariophyceae, Chrysophyceae and Euglenophyceae. The protozoa community was comprised of Mastigophora and Ciliata, that dominated cyanophytes and chlorophytes. The statistical analysis of the relationships between the variation of algae and physicochemical parameters showed that the phytoplankton species defined four phases during the experiment.

REMOÇÃO DE H₂S ATRAVÉS DE BIOFILTRAÇÃO NA ETE DO MUNICÍPIO DE ORLEANS/SC

Paulo Belli Filho
Flavia Andrea Da Silva Cabral
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Emission of odors from Wastewater Treatment Plants has become one of the main reasons for public complaints. With the purpose of solving the problems of odor emissions caused by wastewater treatment, a full-scale biofilter was installed at a Wastewater Treatment Plant in Orleans, State of Santa Catarina, Brazil. The biofilter efficiency will be assessed by a chemical analysis that will quantify hydrogen sulfide, and by an olfactometric analysis that will use three parameters: concentration obtained through the ODILE® olfactometer, expressed as UO/m³; intensity obtained with the use of the 1-butanol reference scale; and hedonicity that requires the filling of a form with pictures representing the level of pleasantness or unpleasantness of an odor. All these analyses use the human olfactory sense. Both chemical and olfactometric analyses

present efficiencies up to 95%. Hydrogen sulfide concentrations, quantified through gravimetric analysis, presented average concentrations ranging from 5.032 to 0.382 mg/m³ at the biofilter inlet and 1.0 mg/m³ to near zero at the biofilter outlet, with efficiency higher than 90%. The concentration obtained by olfactometric analyses at the biofilter inlet was 40,000 UO/m³ with very high odorant intensity and an extremely unpleasant hedonic tone. A concentration of 242 UO/m³ with low odorous intensity and without unpleasantness was verified at the biofilter outlet. The olfactometric analyses show that both concentration and hedonicity present results that show the significant reduction of odorous nuisances.