Efficient treatments of sewage sludge to produce energy and organic fertilizer

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This study was designed to evaluate the biological and chemicalcharacters of sewage sludge generated in Abu-Rawash sewage plant, andthe pos~ibi1ity of producing biogas and natural organic soil conditioner byaerobic I and anaerobic treatments which aimed to the inactivation ofbacteriali and parasite pathogens and to improve the biological and chemicalcharacters of the product from the waste which is known as a great sourceof disease and environmental pollution.~he suitable beneficial reuse of the waste in the soil for the benifit of,the crt· s and man and as a source of energy will be a secure and reliablelong te sludge disposal strategy for the benefit of the society.iological and oiemical monthly : tv aluation of sewage sludge cj ; enerated from abu-raw asewage plant this experiment was carried out to evaluate the chemical andbiological characters of the sewage sludge generated from Abu-Rawashsewage plant aiming to full benefit from this waste. The monthly evaluationfor oneiyear proved that :-• The agronomic value of the sewage sludge which has major elements inaverage 2.32 %N, 0.57 % P and 0.29 % K.• The organic carbon content varied from 41.41 %to 21.73 %.• The total solids per cent varied from 5.64 to 3.18 %.• The CIN ratio varied from 20: 1 to 9 The heavy metal content revealed that some elements were in the allowedlim~ts but there were a considerable exess in some heavy metals content.196• The monthly evaluation proved that the sewage sludge contained somedifferent kinds of parasite ova as, Ascaris, Ankylostoma doudenale,Schisto~ma hematobium...Tinea solium, Tinea saginata, Entamoebahistol ca and Balantidium coli.• The . vestigated pathogenic bacteria namely coliform group, Salmonella& Shi ella, Streptococcus faecalis were found in great numbers duringstudy but Clostridium perfringens was found in some A- AN EROBIC TREATMENTS5-2 : E FECf OF TEMPERATURE ON THEHI METHANATION OF SEWAGE SLUDGETh s experiment was carried out to evaluate the effect of temperatureat 37c’ d 55 c’ on the biogas production and the survival of somepathogen c bacteria and parasites. The results revealed that :- The was an increase in the total biogas production at 55 c: more I than that produced at 37 c’ during the 70 days fermentation. The daily producti~n at the peak was higher by 1.5 times. The biogas cumulative I producti n at 55 c· reached more than twice the production at 37 c’ after 26 days, while after 70 days the incrase was only 11 %.e counts of coliform group, salmonella& shigella, Streptoeoeeusfaecalis Iand Clostridium perfringens were determined in the beginning andat the nd of the study, the rate of destruction was greater at the highertempera e at 55 C· than at the mesophilic temperature 37 c’, effect of temperature on selected parasite survival showed that, at37 the parasite destruction was not completein the case of Ascaris and£!!!!~~~ma~ doudena1e. But non of the Schistosoma hematobium, TineaEntAmoeba histo!ytica was detected at the end of the experiment. Thermophilic fermentation at 55eo probably destroyed all the parasites which were detected at the beginning. 5-3 BI GAS GENERATION from SEWAGE SL GE CONTAINING DIFFERENTCO CENTRATIONS OF MUNICIPAL SO IDWASTES (MSW) Thaim of this experiment was to detect the best biogas productionI from sewage sludge to which was added increasing amounts of municipalI solid wastes then fermented in batch digesters; the results revealed that:I A Ipositive increase in biogas production with TS concentration in thefermenting materials up to 6 %, then decreased at TS more than that. Thebest gas I production was 23.67 liter/fermentor in the treatment of SS+2% MSW, (~% T8). The volatile solids revealed a decreasing order according to! T8 added. The pH in the

fermenting materials during the period of the studyincreased by increasing the T8 concentration. The behaviour of ammoniacal and total nitrogen during fermentation of sewage sludge treatments in relation to the TS content indicated that ammonia concentration increasedby increasing the TS content in the digested material. The data proved adecrease I in nitrogen losses by the increasing ofTS content in the digestingmaterials.Tij.e behaviour of volatile fatty acids showed increasing of volatilefatty aci~s by increasing the TS contente survival of coliform group and salmonella & shigella decreased.The vues obtained showed no great differences at the differentconcen*tions ofTS.ID AS GENERATION DURING TW PHASE FERMENTATION The aim of this experiment was to improve biogas production. The bjective 0 the first phase was to maximise the conversion of volatile sludge solids to e form of volatile fatty acids and to study the performance of theacid phas reactor, the productivity of volatile fatty acids and theiraccumulati n in relation to time, changes of pH, total solids, volatile solids, and amrn niacal nitrogen through the depth of the acid phase reactor. Thequantitativ and qualitative productivivty of biogas in relation to time was estimated t hydraulic retention times 20, 10, and 5 days.The aim of the second phase was to determine the best hydraulicretention . e suitable for methane phase reactor to get the maximum biogasproductio . The data showed that the daily biogas productivity, C14content fr m the fermented sewage sludge in the acid phase increased withdecreasing hydraulic retention time (HRT). The samples which were taken from different ports level in the acidphase fe entor confirmed that :-The pH, TS, Nl4-N and VS values decreased with the depth till thefourth po then increased again.The VFA values increased with the depth till the fourth port thendecreased again. effect of different HRT’s on biogas production in methane phase revealed at the maximum cumulative biogas production at 7 days was 401.7 lite while it was 231.76 and 121.52 liter at HRT 10 and 20 daysrespective y, for 20 days fermentation.A ighly significant negative correlation was found between hydraulicretention . e and biogas production.DIC TREATMENT -COMPOSTING OF SEWAGE SLUDGE AND CIf AL SOLID WASTES (MSW)aim of this experiment was to make combination between the Nrichsewa e sludge with the C-rich municipal solid wastes to reduce nitrogenlosses. T e experiment was carried out also to evaluate the effect ofincreasin temperature during compo sting on some pathogenic bacteria andparasites.’S showed that:-organic matter content decreased with time during the period ofthe stud . The reduction rate of organic matter reached 29.5% in municipal solid wa tes treatment while it reached 16.3% in the dry sludge treatment and lay in between these figures in the tested mixtures. The percentage of nitrogen generally increased but there was a continuous decrease in nitrogencontent. [The true losses reached 5.6% in MSW treatment and reached24.38% I in dry sludge treatment]. elN ratio generally narrowed throughoutthe coipI osting period. This effect was higher in the early weeks andremain at lower uptil the end of the experiment. The CIN ratio narrowingin mu .cipal solid wastes was greater than that of the dry sludge treatment.It narr ed from 37.4 to 19.7 and from 11.9 to 11.1 in municipal solidd dry sludge, respectively. The other treatments lay among thesetwo ra os. Nitrate showed a gradual increase during the first week and ahigh in rease during the second and the third weeks of the study.e data revealed a slight increase in pH values to the second week ofcompo . g and then gradually decreased to the neutral values. Data showedthat th highest temperature reached 64 C·. The dried sludge treatmentshow a lower increase in tempecatuce.ColifPrm group and salmonella & shigel1~ were used as indicator! organisms ifor the destruction of pathogenic bacteria in the end product. The numbers ’1f coliform group and salmonella & shigella bacteria were high inthe initial Isamples. Salmonella & shigella colonies were not detected at the end of th~ experiment. In the dry sludge treatment, coliform group remained present in ~ower numbers (6.5xl01) at the end of the study.Th~ effect of co-compo sting on the survival of selected parasites inI sewage sludge showed a great reduction of the selected parasites in all treatments except the dry sludge treatment behaviour of macronutrients during the co-compo stingexperime t revealed that :- highest content of nitrogen was in the dry sludge and the lowestIII the unicipal solid wastes treatment and the values of the otherwere among these two values. It is worthy to mention that therewas nitr gen losses during composting of the dried sludge. Phosphorusbehavio r revealed the higher concentration in municipal solid wastes +dried sl dge 1:4: the amount reached 0.7%. But the lowest content was0.24 % in the municipal solid wastes treatment. Phosphorus in the othertreatme ts was among these two values.e result s showed that

potassium content in municipal solid wastest was the highest, it reached 0.440/0, but the lowest content was indried s udge tre stment it reached 0.16% K. potassium content in the othertreatme 18 was Bmong these two values. The trace element and heavy metalsevalua on shov red that the concentration of these elements in the endproduc was big'ler than its initial concentration.MICAL TREATMENTS OF SEWAGESL GE WITH QUICK LIME AND CEMENTD ST The aim of this experiment was to evaluate the effect of lime andcement d st additions to sewage sludge on its biological content and chemical charactelistics. Quick lime treatment showed an increase in pH by fermen1ation period till 28 days in control, 5 % and 10 0/0while there was a clear decrease in pH during the fennentation0% and 500/0treatments. At 20% and 50% quick lime treatments,sed with time from 11.46, 12.06 to 8.92 and 10.6 in the 20% andperiod in pH dec50%trea ents repectively.ent dust treatments seemed to take the same trend of quick limewith a slight lowering values.data showed that the maximum release of ammonia occurredafter 7 d ys in both quick lime and cement treatments.C ncerning the effect of quick lime and cement dust additions on thereductio of path ogenic bacteria, the results showed that the coliform groupwas nc ,t detected after 7 days in 20% and 50% quick limetreatm ts, and after 42 and 21 days at 200/0 and 50% cement dusttreatme ts, respe ctively. Salmonella & shigella was not detected in all thetreatme ts after 42 days of the study. Quick lime 20% and 50% treatmentswere m re effec tive than the cement dust at the same concentration. Quicklime tment a1the concentration of 10% was effective after 42 days in thedestru ·00 of 1:ntamoeba-histolytica while Tinea saginata was reduced at20% le el. Scm ,tosoma hematobiwn, Ankylostoma doudenale and Ascarisneeded 50% qukk lime to be oat detected after 42 days of the study.(Lust treatment at 50% was effective in the probable disapl~l1'8Dce of Entamoeba histolytica as well as Tinea saginata Schistoso a hemaJobium. Ankylostoma doudenale and Ascaris afterdays ofth study.Qui k lime addition almost raised volatile fatty acids intensity morethan the e doses of cement dust. The quick lime and cement dustaddition lerated drying which has happened with the storage of theresidues. This effect increased by increasing the fermentation period and by the added amount of cement dust or quick lime. The quick limeand cern ntdust treatments showed increasing losses in nitrogen contentwith incr sing the added amounts of these substances..results showed that the addition of quick lime or cement dust inhigh concentrations as 20% and 50% decreased organic mattermineralization. There was an increase in phosphorus and potassiumconcentra ion in 1hefinal determination of the treatments of quick lime and ! cement dr'st. The results showed that the concentrations of the micronutrientelements Fe, Mn, Cu, Zn, Pb, Co and Ni in the end-product of the quicklime and cement dust treatments as well as control were higher than theirrespective initial concentrations.5-7 BIOLOGICAL TREATMENT OF ANAEROBICD GESTED SEWAGE SLUDGE WITHCORELLA. SP aim of this experiment was to study the effect of algae growing indigested sewage sludge on the chemical and biologicalchanges ofsludge during 15 days growth.revealed that :-rning the removal of ammonia from the culture medium it wasthat in the control and in the added effluent concentrations 5 %,10 0 and 15 to, ammonia was completelyremoved. While the ammoniadecreased in the culture medium containing 20, 25, 50 and 75%roueot. The e ciency of P205 removal from the control (synthetic) medium dueto chl rella growth was 43.390/0. The treatments containing 5%, 10%and 15% biogas effluent showed 100°,/0removal after 15 days. The moreconce trated treatments containing 20°,/0, 25%, 50% and 75% biogasefflue t showed incomplete removal of P20S and the percentage ofP205 removal was 78.850/0,63.330/0,43.070/0 and 17.090/0,respectively.orthy to say that the chlorophyll (a) content in 25% biogas effluentent was better than the control (synthetic medium). Chlorophyll(a) ntent was increased gradually with increasing biogas effluentto 25% then decreased with further increase of The rghest biomass production was achieved from the treatment of 25% conttration biogas effluent (6.5 gIL). The higher and lowerconrtrations showed lower dry matter content.ding protein content, the same results of biomass was observed.highest protein content production was 2.99 gIL at 25%, reduction of chemical oxygen demand (COD) and biological oxygen d (BOD) evaluation showed that at 5%, 10%, 150/0,20%, 25%50% biogas effluent concentration, there was a complete destructione organic matter. At the higher concentration of the biogas effluent(7 0/0) algae could not be able to remove all the organic matter. Theefficien y of COD reduction was 68.7%. The efficiency of BODreducti n was 65.62% at 75% ofbiogas effluent concentration.• The re uIts about the

inactivation of pathogenic bacteria showed that thebiogas effluent concentration 5%, 10%, 15%, 20%, 25%), and 50% whentreated with Chtlorella sp for 15 days removed pathogenic bacteriacompletelyfrom the counting plates. The higher biogas effluent treatment750/0 ecreased coliform group counts from 5.8xlOJ to 6.()”I •.~. ’}. afterdays g owing period.• The h vy metals in the treatment containing 5, 10 and 15 % sewagesludge effluent was completely removed after 15 day of growingchlore lao Mn, Cu, Ph, Cd and Ni were removed in the 20% and 250/0trea nt; increasing the concentration did not increase the removalefficie cy. Reco’nu’laendotions :-1- It is ecommended to raise the temperature of fermentation in order toincrease methane production and to activate the removal of pathogenicbactfa and parasites.2- The dition of municipal solid wastes (MSW) to sludge increased gases prod ction up to 6% TS.e two-phase fermentation technique the hydraulic retention timenot exceed 5 days in the acid-phase and 7 days in the methane4- Co-co sting sludge and municipal solid wastes showed the bestt the rate 4 : 1.5- The be t treatment of sludge with quick lime and cement dust was 20 %for bo chemicals.6- The hi logical treatment of anaerobic digested sewage sludge effluent with C lorells sp must be practiced at the concentration 25% of biogas effluen.