

TA004

WASTE PROCESSING AND REMEDIATION

NEW APPARATUS FOR TOXIC WASTE AND SLUDGE TREATMENT AND FOR PLASMA PROCESSING OF FUME BY MICROWAVE POWER TECHNIQUE.

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ABSTRACT

It is the presentation of a pilot scheme in Industry where microwaves are used at a number of locations for processing toxic waste and sludge as a means of reclaiming some by-products. The waste contains initially a high percentage of water and toxic compounds. Originally the moisture content is reduced to about 80% using a DIEMME filter press. Microwaves are then used in a screw-type applicator to reduce the moisture to less than 25% using a number of microwave sources feeding the energy in the long applicator. Further, the introduction of microwave energy downstream in a special incinerator produce suitable reactions such as the release of Chlorine or Halogens from the molecule. Finally, microwaves are used to create a plasma torch, the high temperature of which destroys molecules and fumes to atoms and to metal oxide thus reducing the residual of the waste and the ensuing pollution.

INTRODUCTION

It is known that the effects of the microwave power on materials are Electroheating, chemical transient species formation improving reactivity and chemical plasma processes, (1) The effect is higher as higher the dielectric properties of the material are. The double effect of the microwave power is usable to dry and to destroy waste and sludge. The wastes contain a high percentage of water and toxic compounds. Its moisture is more than 90% of the total weight. The first effect of those processes produces the drying of the waste down to 30% of moisture or more. Further the microwave radiation produce suitable reactions such as release of Chlorine or Halogens from the molecules (2) or formation of reactive species (3) and chemical plasma. The high temperature of the plasma destroys compounds to atoms and to metal oxide further reducing the amount and the volume of the residuals.

The present communication concern the description of new Laboratory prototypes and Industrial apparatus to dry and to treat sludge and wastes with microwave power for their thermo-destruction and to overthrow the fume by microwave plasma. The scale up starts from new laboratory and pre-industrial models to industrial apparatus.

LABORATORY MODELS AND METHODS

The laboratory model for the thermodestruction of the dried sludge has been assembled with a combustion chamber of 2 litres volume, a heat exchanger for basic and another for acidic vapour. At the end of the plant there is a chamber with several filter to stop the fume. Totally there are five steps with the control of the gas and vapour after each step.

The results show a drastic decrease of SO_x, NO_x, and organics. No traces of dioxin or chlorine organics derivatives were found by spectroscopic analysis.

The pre-industrial disposal for 10 kg of sludge was assembled as previously described but with the presence of an accessory to inspire air and vapour through the plant. At the end a microwave plasma was put on the place of the filter chamber a microwave plasma system as second combustion chamber. The

plasma power was formed by a 2 kWatts microwave generator. During the process the gas, vapour and fume were analysed and the data compared with the last emission. No organic residuals were found but a high increase of N and C oxide was formed conforming to the almost total destruction of the sludge.

PILOT INDUSTRIAL PLANTS

The experimental results obtained with the previous disposal were used to manufacture the Industrial apparatus: two ones basically different to dry the moister of the sludge and one to incinerate waste and sludge and to treat the fume and other residual vapour.

The drying system was of two types: one moving the materials with cochlea device, (fig.1) and the other moving by a conveyer belt (fig. 2), both assembled with twenty microwave generators of 2 kWatts power each one, (fig.3) for the irradiation. The control of the temperature under the window of the generators is made by a thermostat which shut off the microwave generators if the temperature is too high presumably for burning material. The drying systems treat an amount of 150 kg per hour.

The special incinerator (fig.4) use the microwave power radiations to treat the fume and to produce a microwave plasma flame of 6 kwatts power, located just after the second incineration chamber. Others four 2 kwatts microwave generators are assembled before the fume cap to stop any formation of chlorine derivatives and to improve the local temperature.

The flame of the incinerator is ingited and remains lit by another microwave plasma torch with a plasma gas tube of 82 cm. The incinerator can treat up to 250 kg per hour.

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fig1



fig2



fig3

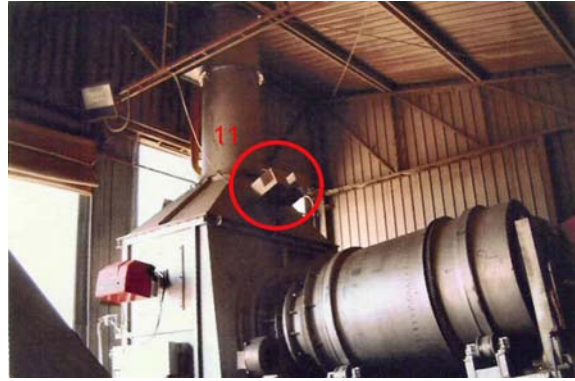


fig4



fig5