MIKROWAVES ASSIST AFTER COMBUSTION OF POLLUTIONS IN GASES

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One of the most crucial elements of natural environment is air, its chemical composition, presence of dust and fibre particles or other contaminants. Unfortunately urban development, rapid industrial growth and very often reckless human activities are the reasons for very serious air contaminations and that is a threat for human health and has negative influence on natural world. An illustrating example may be incineration of some substances, including waste, in kilns and in incineration plants which are not providing efficient oxidation (after combustion) of organic substances and are not equipped in proper systems for purification of exhaust gases. The result of such case is an increased level (above legal norms) of hydrocarbons, carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) etc. in exhaust gases and also strong, offensive odours which may be disturbing for people living in the vicinity area.

Very often installations equipped with expensive catalyst systems for purification of gases are the source of harmful emission, because they do not meet technical standards of installation which would ensure effective gas purification. For example, if ceramic catalysts systems for exhausting gases purification in incineration plants are of not operating in optimal range of temperature their efficiency significantly drops. This results in growth of emission of 'not completely burned' contaminants and the surface of the catalysts gets covered with soot and other solid contaminants which cause the permanent inefficiency of catalysts.

There are a number of other sources of air pollution, such as food processing plants emitting offensive odours, varnish factories emitting fumes of various kinds of solvents, chemical processing plants, etc.

On other hand there are many known methods for gases purification, including filtering systems, mentioned above catalyst systems for after combustion of contaminants, plasma systems and ozone reactors supporting oxidation process. The selection of appropriate purification system depends on the type of contaminants, quantity of emission, costs and other factors both technical and economical.

This article describes a new method for purification of gases. The method is aimed to be an important supplement or an alternative for numerous methods known so far.

Microwave Oxidation System (MOS) was developed and implemented by ATON-HT Company. The MOS method is based on application of microwave energy and special kind of ceramic elements for heating up gases and improving the oxidation of contaminants in exhaust gases.

The essence of proposed technological solution lies in thermal treatment of gases containing not completely oxidized (not completely burned) organic components, hazardous chemical substances and some nonorganic compounds. Proposed method might be applied in various (already functioning) installations of thermal waste treatment and other thermal processes plants. The concept may be a base for creating completely new kinds of reactors for waste neutralization.

This new method of 'after combustion' of exhaust gases in conventional incineration plants and other devices designed for thermal neutralization of waste is based on introduction of contaminated gases into a metal chamber filled with ceramic balls, which are heated by the microwaves to the temperature of approximately 1000 - 1300°C. Efficient heating of ceramic balls (or ceramic elements of other shape) is achieved by appliance of a special type of ceramic material which is durable for high temperatures and at the

same time efficiently absorbs microwaves, within the absorption band of 0,5 Ghz - 4 GHz. In contrary to this, ceramic material used for thermal insulation in reactor's walls is characterised by low attenuation of microwave energy, even in high temperatures (approximately 1000°C).

In order to make oxidation process more effective and complete, additional air or oxygen is introduced to the chamber (ozone might be also introduced). Exhaust gases passing through ceramic balls (forming ceramic bed) are heated to high temperatures due to appliance of outside microwave power. In high temperature and in excessive concentration of oxygen introduced into reactor together with additional air stream, impurities in gases are promptly oxidized. Time of 'passage' for gasses through MOS reactor could last even up to 4 seconds, what guarantees efficient after combustion (oxidation) of all organic components of a purified gas. The optimisation of the system is necessary for real installations. For example, by assorting process conditions, including quantity of introduced air by minimising contents of carbon oxide in exhaust gases.

Described method is show in brief in the figure 1.

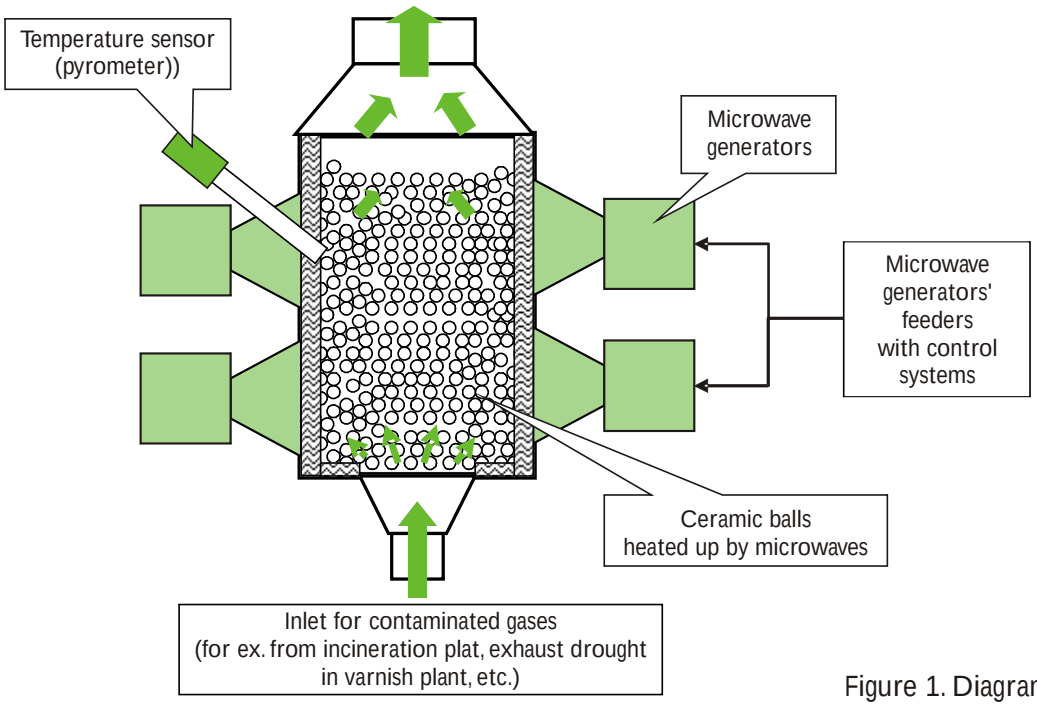

Figure 1. Diagram of MOS Reactor.

Hot gases leaving MOS reactor, might be - depending on its content - introduced into conventional catalyst systems or emitted to the atmosphere. If there is a need for further purification applied purifying systems will be much smaller than in case of conventional purification systems, without application of the proposed solution.

In order to achieve much lower energy consumption, MOS reactor might be equipped with heat exchanger, where energy of hot gases exhausted from MOS Reactor will be used for heating gases introduced to the reactor. This solution is presented in Figure 2.

The idea of presented system is analogical to the performance of after combustion systems equipped with gas burners. For effective after combustion of impurities in exhaust gases for conventional incineration plants, it is necessary to heat exhaust gases up to the temperature of approximately 1200 - 1300°C and introduce appropriate amount of oxygen plus keeping such a mix for at least 2 seconds.

Crucial advantage of presented method is minimisation of amount of exhaust gases, because the proposed method does not have any combustion gases from after combustion burners (this method does not

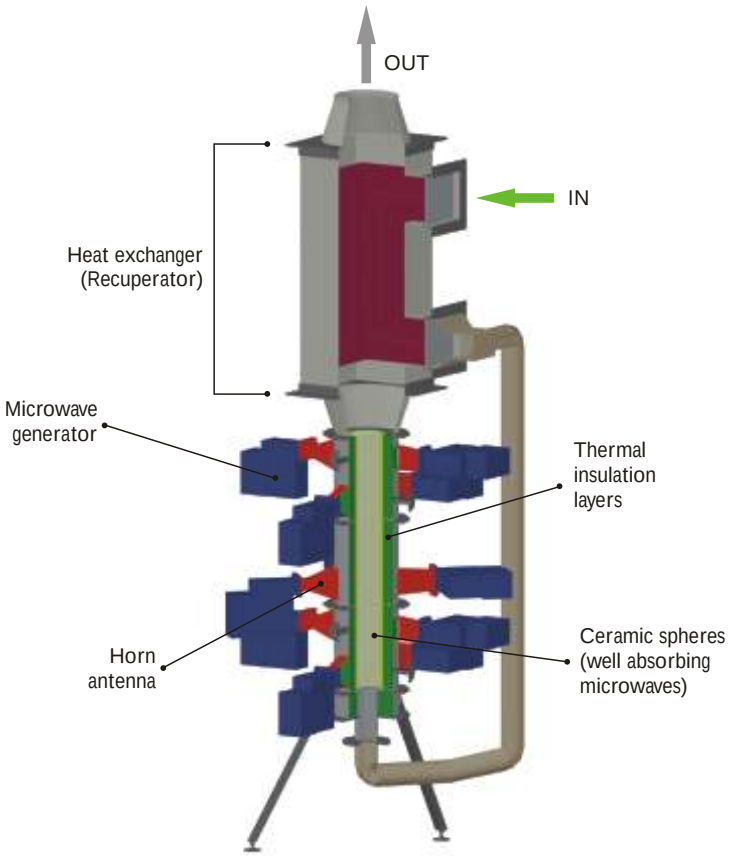

Figure 2. Construction of MOS reactor equipped with heat exchanger.

need burners at all). Smaller amount of exhaust gases enables reduction of the size of after burner and reduces energy consumption required for after combustion process. Moreover, this system enables a very precise control over keeping optimal gases temperature what guarantees obtaining high efficiency of the process. It is also important, that emission of combustion gases (CO_2) in proposed system is much smaller than in conventional systems.

Presented solution is currently a subject of surveys in order to establish optimal working conditions depending on composition of purified gases, temperature and amounts of gases. Those surveys will mainly cover analyses of chemical composition of gases before the oxidation process and after leaving MOS Reactor. It is expected, that results of surveys - except for optimization of gas purification process (due to recognition of all processes undergoing in such reactors), will significantly extend the scope of its practical appliance.