TRANSITION FROM "MUCROSCALE" TO "MICROSCALE" HEAT TRANSFER - THE BASYS FOR COMBUSTION ASSISTED TECHNOLOGIES OF 21 SENTURY

Serguei ZHDANOK

Chemical Physics Laboratory, Heat and Mass-Transfer Institute, Academy of Sciences of Belarus, P. Brovki 15, Minsk 220072, BELARUS.

Traditional combustion assisted technologies assume the "mucroscale" energy transfer from the combustion products to the treated materials There are some disadvantages of such energy transfer processes resulting in the high level of pollution, big energy consumption, nonuniform temperature distribution at the surface of treated materials, big scale of the equipment that is needed for processes realization. At the same lime the real scale of combustion phenomena that are used in many technologies is very small and can be considered as "microscale" compared to the energy exchange scale The objective of this paper is the formulation of general principles and demonstration of advantages of new approach to the combustion assisted technologies based on the porous media combustion under filtration conditions The porous size is the measure of scale for all the processes going on in porous media and that's why the scale of heat exchange between the combustion products and porous material surface can be reduced by changing the porosity of the body where the combustion is realized The main difference between the traditional "mucroscale" combustion assisted processes and "microscale" porous media combustion is the following: the process temperature in the "microscale" heat exchange area is not any more the function of fuel caloric affect as it is in usual "mucroscale" process but is the function of filtration conditions and that's why it can be regulated by changing such a parameters as porosity, material properties (thermal conductivity, thermal capacity, radiative properties), gas flow-rate and geometry of the equipment For a example, the temperature in front of methane/air combustion wave under mixture filtration in porous media can be few times more high than in the usual combustion wave [1]. This phenomenon can be used for combustion of very diluted fuel/air mixtures and has high potential for environmental applications The same effects of superadiabatic process temperature appear in sintering process [2], cigarette smoking process [3], glass wool materials thermal treatment and many other industrial and natural processes. The simple physical and mathematical model developed for description of "microscale" heat exchange effect on the combustion processes parameters is presented in this paper This model is applied to real combustion processes and combustion assisted technologies

The problems of combustion stability as well as the problems of numerical modeling of the porous media combustion are discussed. Special attention is paid to the problem of industrial scale radiative burners design and polluted gases treatment as well as to the problems of the solid waste and polluted soil treatment The principle problems limiting the wide penetration of "microscale" heat exchange based combustion assisted technologies to industry are analyzed and possible ways of their solution are discussed in the paper.

References :

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