MASS TRANSFER IN THE PROCESSES OF SUPERADIABATIC COMBUSTION FOR THE EXTRACTION REGIME OF SOME METALS FROM DIFFERENT SOURCES

A. Rozenberg, I. Gudkova, D. Lempert, G. Manelis

Institute of Problems of Chemical Physics, Russian Academy of Sciences
Chernogolovka, 142432, Russia
E-mail: asroz@icp.ac.ru

During the last twenty years at the IPCP RAS the scientific basic and new technologies using the filtration combustion processes in a superadiabatic regime are being studied intensively. In the case of the backflow of solid phase containing a fuel and a gas-oxidant (usually, air) at correct matching of gas flow and fuel concentration in the solid phase it is to reach very high temperatures in a narrow moving zone much higher than those that may be realized in ordinary combustion processes when all released heat is distributed among big reagents mass. The main advantage of the technology based on the superadiabatic regime is an energy-efficient process. Using this method it is possible to burn effectively too low-calorie mixtures that cannot be burnt in other conditions. Besides, it is possible to use a low-calorie fuel (e.g., high-ash coal) for this process. New technologies of incineration of home and industrial waste, lignin, and many other objects based on CHNO-atoms are already under development [1].

A few years ago the IPCP RAS started investigating filtration combustion for the media containing, besides CHNO-elements, other elements and metals. First, these investigations had the main goal to reveal the ecology safety of waste burning. However during this study it is shown that it is possible to use the filtration combustion purposefully for many metals extraction from industrial wastes, poor ores, burrows, etc. The most applicable for this purpose are the initial sources containing metals that can create accordingly high volatile substances (products of oxidation as well as of reduction), which would move with the gas flow and either exit from a charge or at least considerably increase a metal content in the tail and, consequently, to obtain enriched concentrates applicable for further utilization with traditional methods.

The thermodynamic research of systems mostly applicable for metal extraction has been performed. Sources containing zinc, cadmium, molybdenum, and tungsten have appeared best fruitful for initial investigations. It is shown theoretically that zinc and cadmium must exit in the form of gaseous metals. Hereby one has to organize the filtration combustion process with the so-called inverse wave that appears when the most part of the released heat is accumulated in the reduction zone. For molybdenum extraction in the form of trioxide one should organize the so-called normal wave that appears when the most part of the released heat is accumulated in the oxidation zone. If the source contains tungsten, one should introduce a water stream into the gas-oxidant because hydroxides $(HWO)_n$ are the most volatile among W-containing substances.

The filtration combustion of systems containing molybdenum and tungsten have been investigated – industrial molybdenite (MoS_2, the main initial source for molybdenum production), used catalysts containing molybdenum, dump tungsten wolframite cakes (technology residue after autoclave-soda processing of wolframite). It is shown that the molybdenite burns practically at 100% with the forming of MoO_3-needles of very high purity. Hereby the system does not need coal because the molybdenite is a fuel itself. In the case of catalysts with molybdenum (here the carbon fuel is necessary) the molybdenum trioxide is alsoformed, the extraction level is up to 70%. The optimal regimes (temperature, rate of gas-oxidant flow, coal content in a mixture) of the processes are found. On the example of dump tungsten wolframite cakes with 4.0-4.5 % WO_3 it is shown that if the gas-oxidant contains water, one can extract at least up to 30% of initial tungsten

Reference

[1] Manelis G.B., Polianchik E.V., Fursov V.P. Energy Technology of Burning Basing on Superadiabatic Heating. Chemistry in interest of stable development. 2000. V. 8. P. 537-545.