year month day
2013 9 30

Environment and Life Engineering		ID	079407
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Abstract

Title	Non-thermal Plasma Combined with Modified Adsorption Catalyst for Removal of NOx

(800 words)

Non-thermal plasma (NTP) assisted catalysis is one effective method to remove NOx from diesel engine exhaust. This thesis reviewed the development of plasma and catalyst investigation firstly, and then prepared three kinds of catalyst which are based on Sepiolite, Attapulgite clay and coal derived Activated Carbon, and evaluated their performances and propose plasma catalysis model. The conclusion is showing as follow:

(1) As the Sepiolite, Attapulgite clay and Coal-based Activated Carbon has a special structure, such as a large of surface area, a number of micro-pore, a good stability and low costs, they are suitable as catalyst carrier.

(2) Some unpurified materials are in the original of Sepiolite, Attapulgite clay, so acid washing can remove them effectively. Meanwhile, acid modified treatment can increase and improve the surface area and structure of Sepiolite and Attapulgite clay. The results of this study have proved the acid concentration, acid washing time, the kind of acid can affect the activity of catalyst and NOx removal rate effectively. With increasing the acid washing time and acid concentration, the activity of the catalyst increases firstly and then decreases. There is an optimum value for NOx removal rate. The affect of washing by HNO3 is better than of HCl.

(3) The calcination temperature of activated catalyst has a significant influence on the NOx removal rate. When the temperature is in the range of from 400 oC to 600 oC, the catalyst has a good ability for NOx absorbing and storage. If the temperature is too low, the catalyst activity can not achieve sufficiently. If the temperature is too high, the structure of catalyst will be melted and the surface area decreases.

(4) NOx removal rate increases with the increasing of input voltage. At the beginning, the reaction rate is high and then gradually decreases and trends to be stabilized, because NTP can effectively reduce the initial activation energy, and enhance the adsorption and storage function of catalyst.

(5) The ion of $NO3^-$ was detected in the leaching solution of used CACC by the Nitrate Ion Detector. According to the ion of $NO3^-$ and PH value of the leaching solution, the NO is absorbed on the surface of CACC firstly and then oxidized to NO2 and further to $NO3^-$.

(6) The gas concentration, gas space velocity and the catalyst packed weight have certain effect on the NOx removal ratio. The NOx removal rate increases with increasing the initial NO concentration, when the initial NO concentration exceeds a certain critical value, the NO removal ratio decreases. With increasing of the space velocity, the NOx removal rate increases and then decreases, showing a peak value of the removal rate.

(7) The order of NOx removal efficiency is: plasma with catalyst > Plasma with glass bead > only catalyst > only plasma, because the catalyst has not only the performances of catalysis, adsorption and storage, but also fully play the role of the DBD.

(8) In terms of the NOx removal rates at the same condition, it is found that the Coal-based activated carbon gives the best performance in contrast with the modified sepiolite catalyst, modified attapulgite clay catalyst. The catalyst is very cost effective and it can be easily regenerated.

(9) By the results of a simplified model and experiment, there is a suitable size of catalyst in the DBD reactor and it effects on the discharge power and NOx removal rate. The optimal diameter of catalyst can be predicated in terms of structure of reactor and operational conditions.

Coal-based activated carbon catalyst and plasma synergistic effect is better than the catalyst modified Sepiolite catalyst synergy effect, but modified Sepiolite catalyst with the plasma a considerable synergistic effect, and because of the price of Sepiolite, taking economic into consideration, the method of preparing Sepiolite Catalyst needs a further improvement, to provide efficient carrier catalyst.

This research need to be developed further to improve energy efficiency so that it can be applied to cleaning of air containing low concentration NO, for example, large underground car park or large automobile tunnels and other places.