ANALYSIS OF THE POSSIBILITY OF USING MCM-41 MESOPOROUS MATERIAL FROM FLY ASH TO REMOVE NOx FROM WASTE GASES

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INTRODUCTION

N_2O, commonly called nitrous oxide, is a greenhouse gas whose molecules absorb heat. The concentration of nitrous oxide from the beginning of the industrial revolution in the atmosphere increased by approximate 16%, which resulted in a strengthening of the greenhouse effect by 4-6% [1]. This leads mainly to the intensification of the stratospheric ozone decomposition process and consequently, the increase in the amount of UV radiation reaching the earth's surface. For this reason, researchers are looking for new ways to reduce NOx. In the presented research, a mesoporous MCM-41 material was proposed synthesized from fly ash as a catalyst carrier. In selected processes, catalysts based on cobalt and copper are used [2].

EXPERIMENTS

The proposed catalyst carrier was the Mesoporous MCM-41 material, which was obtained from fly ash remaining after the combustion of hard coal in the Polish thermal power plant. This material was obtained by means of extraction and synthesis. The obtained material was subjected to the XRD test.

MODIFICATION OF MCM-41 MESOPOROUS MATERIAL

In order to modify the MCM-41 mesoporous material, two samples were selected, and then each of them was divided into two parts by weight. Division resulted in samples 3a, 3b and 4a and 4b, which were then subjected to the process of applying ions to adsorbent surfaces. To the four conical flasks, the weighed amounts of MCM-41 mesoporous material and the corresponding solution were added. Then it was shaken, filtered, then the samples were calcined. The products so obtained were subjected to selective catalytic reduction of nitrogen oxides using NH_3 as a reducing gas [3].

DEPENDENCE OF NO CONVERSION RATE ON TEMPERATURE

Samples of mesoporous material activated with Cu^{2+} ions achieve a higher degree of conversion (within 70%) for lower temperatures, whereas as the temperature rises, this value decreases. The exception is the first measurement for sample 3a, where the conversion rate is much lower. In the case of samples modified with Co^{2+} ions, the value of conversion is much smaller, it is 30% for material 3b at high temperatures, while for sample 4b it is kept low by several percent. The data show that by far the largest N_2O production was recorded for sample 3a material Mesoporous MCM-41 activated with Cu^{2+} ions. Comparing the amount of produced NO with the degree of NO conversion, we can see that even at 300 ° C, where the reaction of nitrous oxide was the lowest, this amount is still higher than the produced N_2O. As the temperature rises, the amount of N_2O formed is increasing, which may indicate a greater contribution of the NH_3 oxidation process.

For sample 4a also modified Cu^{2+} production of nitric oxide is high but comparing it with the degree of NO conversion it can be seen that the amount of nitric oxide removed is much higher. As with the conversion rate, sample 4a retains the most stable amount of N_2O production as the temperature

increases. From the graph we are not able to deduce which of the reactions of dinucleotide oxide formation could have a larger share in the obtained results.

RESULTS AND DISCUSSION

Sample 3a shows a high level of N_2O production. As the temperature rises, the amount of NO increases, while the conversion rate decreases. In the changing conditions of the process, the sample 4a of the MCM-41 mesoporous material activated by Cu^{2+} appears to be the most stable, NO conversion rate oscillates around 70% and the amount of N_2O produced at 160ppm. Due to its stability, it can be concluded that from all the mesoporous material samples tested in the above work it is most useful for removing NOx from waste gases. Sample 4b modified with Co^{2+} ions shows the lowest values of NO conversion and proportionally the highest N_2O production. Of the MCM-41 samples tested in the above work, it can be assessed as the worst material for removing nitrogen oxides from flue gases. Looking at the results of sample 3b of activated Co^{2+}, it should be noted that this material at low temperatures, desirable due to the location of the SCR installation behind the electrostatic precipitator it has low conversion rates and the amount of N_2O produced is higher. Only at upper temperatures there is a significant increase in the conversion rate in the production of NO.

CONCLUSION

This above work presents research on the use of MCM-41 mesoporous material made from fly ash to remove nitrogen oxides from waste gases. The best results were obtaine with sample 4a by Cu^{2+} activation. It showed high stability changing process conditions, achieving a conversion rate of NO at the level of 70% and the amount of N_2O produced at 160ppm, with an initial concentration of NO equal to 800ppm.

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