FEATURES OF FULLERENE SYNTHESIS BY ARC METHOD

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INTRODUCTION

At present the most wide spread methods for fullerene production are electric arc and laser ones. On a semicommercial scale the are method is fairly promising [1]. Operating efficiency of existing plants reaches 24 %.

The absence of information on operating parameters of the particular plant does not allow to use it under optimum conditions. As all existing plants have different geometry, each of them has individual optimum operating conditions.

Connection of to identical reactors with a pipe (like communicating vessels) allows the investigation into influence of different paramters on the synthesis exept for the effect of the gas phase pressure.

RESULTS AND DISCUSSION

In these investigations we have used the two-reactor electric arc plant with self-feeding the consumable electrode. The plant contains the synchronous system to shift cathodes. As anodes evaporate, cathodes are moving at the same velocity and the gap between the cathode and the anode is kept fixed. Electrodes are graphite rods located in reactors vertically.

Features of arc synthesis of fullerene containing soot (FCS) have been considered in the work. Qualitative and quantitative fullerene content in FCS has been determined by standard samples. Analyses of the operating conditions used in the plant, and the soot synthesized under them have given possibility for selecting optimum conditions for synthesis.

The plant parameter effect has been determined by analysis of quantitative FCS composition. Time for synthesis of combustion products, length of spent rods and helium pressure have been kept the same during the continuous operation of reactors. However other parameters (arc voltage and current) differred. All parameters affect a value of fullerene concentration in soot essentially.

In view of features in the plant construction the operating conditions differ in the reactors. Amount of soot in them is also different. The first reactor has been found less efficient than the second one. FCS yield in the first reactor makes up about 28.12 %, in the second one - 30.21 % of the initial rod mass. Arc discharge power has been changed in the range of 5.4-7.3 kW what on the average amounts 6.31 and 6.38 kW for reactors, respectively. In reactors helium pressure varied in the range of 194-208 Torr, voltage on cathodes - 30-39 V, current - 150-195 A. Analyses of the the fullerene content in soot have shown that common parameters of operating conditions in the first reactor, in spite of the low soot yield, have promoted its enrichment in fullerene fraction. In the first reactor fullerenes make up on the average 8-9 % of soot, in the second one - 6-8 %. Analyzing parameters for operating conditions in reactors, and qualitative and quantitative fullerene content in soot synthesized, one can conclude that the helium pressure and the rate of soot synthesis affect the soot composition considerably. In our reactors the optimum conditions for soot production are: arc current 170-190 A, voltage - 32-37 V, power 6.2-6.5 kW, helium pressure - 198-200 Torr. In this case FCS yield makes up about 30 %, and the fullerene content in it varies in the range of 8-14 %..

CONCLUSIONS

Optimum conditions for synthesis of FCS produced in the two-reactor electric arc plant have been selected. It has been found that the helium pressure and the evaporation rate affect the qualitative and quantitative fullerene content in soot considerably.

It has been determined that amount of FCS produced under optimum conditions makes up on the average 30 % of the initial graphite electrode mass.

Fullerene content in soot varies in the range of 8-14 %.

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