Energy consumption of mechanochemical equipment being used for treatment of humic acids sources: brown coal and peat

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Keywords: mechanochemistry, humic acids, brown coal, energy consumption

DOI:10.36291/HIT.2021.008

Mechanochemical treatment of brown coal and peat is widely used in industry and is under investigation for decades. Mechanical treatment of brown coal with sodium percarbonate allows one to oxidize its organic matter, which leads to the increasing of the yield of humic acids and the content of oxygen-containing moieties [1, 2].

For mechanochemical processing of brown coal and peat, mechanochemical equipment with a shock-shear type of action is most often used: planetary ball mills (laboratory scale), centrifugal roller and vibrocentrifugal mills (industrial scale). It is known that for all types of mechanochemical equipment a significant part of the energy is spent directly on the movement of grinding bodies and turned into heat, and only a small part is spent directly on the mechanochemical process. In this work we search for a possibility for energy efficiency improvement by the example of laboratory planetary ball mill AGO-2 and semi-industrial centrifugal roller mill RM-50.

The obtained for brown coal and planetary ball mill data is summarized in Table 1. The effect of mechanochemical treatment is clearly seen: the yield of water-soluble humic acid increased more than ten times for all samples. Variation of ball/reagent loading ratio have proved to be a useful tool for energy efficiency optimization for mechanochemical-assisted extraction of humic acids from brown coal. Rational selection of conditions for mechanochemical treatment allows near the same increasing of the yield of humic acids, with the half of the specific energy consumption.

Table 1. Characterization of samples treated with different ball/reagent mass ratio

Treatment mode, ball/reagent ratio	E, W*h/g	HA yield, %	EPR, a.u.
Init. coal (Itatskoe dep.)		< 1%	592.9
200/10	23.0	12 ± 3	696.3
200/20	11.5	14 ± 2	670.0
175/10	22.0	15 ± 4	611.0
150/10	21.0	21 ± 3	785.1
150/20	10.5	15 ± 2	547.8
125/10	19.6	20 ± 3	721.5
100/10	17.9	19 ± 1	742.6

(E, W*h/g – specific energy consumption, HA yield – the yield of water-soluble humic acids, EPR – amount of paramagnetic centers, a.u.)

Acknowledgements. This study was supported by the Russian Science Foundation (project no. 19-73-10074)

References

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