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Mechanochemical destruction of DDTs with Fe-Zn bimetal in a high-energy planetary ball mill

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Research Highlights

- DDTs were efficiently destructed when grinding with Fe-Zn bimetal powder in a planetary ball mill.
- Mathematical relationships were established by the Discrete Element Method (DEM).
- The main driving force for destruction of DDTs was the normal impact energy.

ABSTRACT

Mechanochemical destruction has been proposed as a promising, non-combustion technology for the disposal of toxic, halogenated, organic pollutants. In the study presented, additives including Fe, Zn, Fe-Zn bimetal, CaO and Fe_2O_3 were tested for their effectiveness to remove DDTs by MC. The results showed that Fe-Zn bimetal was the most efficient additive, with 98% of DDTs removed after 4 hours. The Fe-Zn mass ratio was optimized to avoid possible spontaneous combustion of the ground sample during subsample collection. Inorganic water-soluble chloride in the ground sample increased by 91% after 4 hours of grinding, which indicated dechlorination during destruction of DDTs. In addition, relationships were established between the rate constant and the rotation speed or the charge ratio. Discrete Element Method (DEM) modeling was used to simulate the motion of the grinding ball and calculate both total impact energy and normal impact energy. The latter expressed a stronger, linear correlation with the rate constant.