Power generation from chemically cleaned coals: do environmental benefits of firing cleaner coal outweigh environmental burden of cleaning?

Power generation from high-ash coals is a niche technology for power generation, but coal cleaning is deemed necessary to avoid problems associated with low combustion efficiencies and to minimize environmental burdens associated with emissions of pollutants originating from ash. Here, chemical beneficiation of coals using acid and alkali–acid leaching procedures is evaluated as a potential coal cleaning technology employing life cycle assessment (LCA). Taking into account the environmental benefits from firing cleaner coal in pulverized coal power plants and the environmental burden of the cleaning itself, it is demonstrated that for a wide range of cleaning procedures and types of coal, chemical cleaning generally performs worse than combustion of the raw coals and physical cleaning using dense medium separation. These findings apply for many relevant impact categories, including climate change. Chemical cleaning can be optimized with regard to electricity, heat and methanol use for the hydrothermal washing step, and could have environmental impact comparable to that of physical cleaning if the overall resource intensiveness of chemical cleaning is reduced by a factor 5 to 10, depending on the impact category. The largest potential of the technology is observed for high-ash lignites, with initial ash content above 30%, for which the environmental benefits from firing cleaner coal can outweigh the environmental burden of cleaning for some impact categories. Overall, we recommend to policy makers that coal cleaning using acid or alkali–acid leaching procedures should not be considered for direct implementation as a coal beneficiation technology. We encourage further research on chemical cleaning and its optimization, however, as chemical cleaning has advantages that might make it attractive for cleaning of difficult to treat coals when compared to the less efficient option of physical cleaning.

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