INVESTIGATION ON THERMAL STRESS INDUCED COAL PARTICLE FRAGMENTATION

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INTRODUCTION

Coal particle fragmentation is a common phenomenon occurs during various coal utilization processes. The fragmentation induced size reduction significantly influences the coal heat treatment processes in many different ways:

- decreasing the carbon conversion efficiency because of the increased number of un-reacted fine carbon in fly ash.
- reducing the burn out time of coal particles.
- increasing the heat and mass transfer rate because of the enlarged specific surface.
- others

In the present work, an investigation on coal particle fragmentation was conducted within a drop-tube furnace. The influences of different factors and the fragmentation mechanism were discussed.

METHODS

One single particle or a batch of particles of different coal samples were introduced into the drop-tube from the top and then collected from the bottom after heat treatment (Figure 1). Particle number and particle size distribution before and after the heat treatment were analyzed by the CAMSIZER, which is capable of measuring the particles rang from 30 µm to 30 mm, and thus the fragmentation intensity was determined, quantified by the number of fragmentation index ($I_f$):

$$ I_f = \frac{R_f}{F_d} $$

Where $I_f$ is the fragmentation index, $R_f$ is the fragmentation ratio and $F_d$ is the size change ratio.

RESULTS

The fragmentation intensity monotonously increases with particle size and heating temperature, and generally decreases with the increase of porosity and tensile strength.

As the temperature increases, the fragmentation will initiate with the tensile failure at particle centre, and with further temperature increase, the fragmentation caused by tensile stress and compressive stress both occur. The tensile stress make the inner part of coal particles fragment into several relatively large particles and the compressive stress make the outer part fragment into more fine particles, in good agreement with observed experimental phenomenon.

CONCLUSION

Coal particle fragmentation under high heating temperature and heating rate was found mainly caused by thermal stress. The developed thermal stress model can well explain the fragmentation initiation process and fragmentation pattern.

REFERENZEN