A study of the effects of concentration on the performance of a cyclone separator with oil shale ash

31th OSS

Introduction

Oil shale is considered a vital alternative fuel source. Utilization of oil shale mainly includes burning and oil refining, both of which generate hot flue gas that requires pollution control. Compared with electrostatic precipitators and baghouse-filter systems, cyclone separators offer a favorable balance of separation efficiency, reliability and cost of investment, operation, and maintenance, especially under the high temperature conditions expected in oil shale processing. But, few reports on the separation performance of cyclone separators in oil shale applications exist.

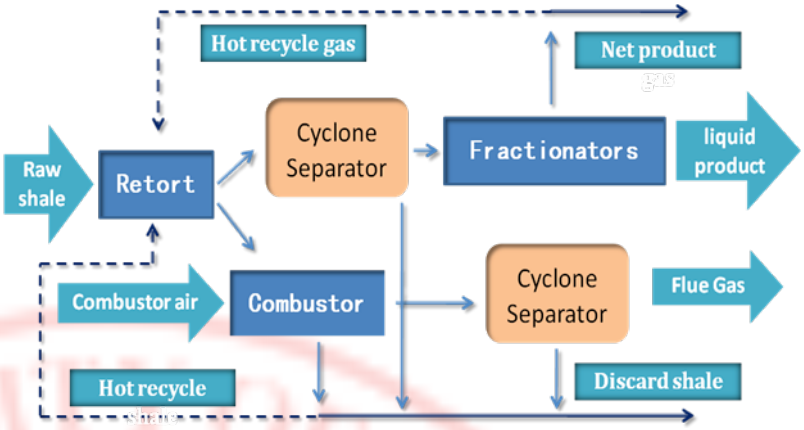

Figure 1 General shale retorting process

Main work

In this study, the separation performance of a cyclone separator with oil shale has been investigated under room temperature conditions to lay a foundation for the design and optimization of cyclone separators for use in the oil shale industry. A 300 mm diameter cyclone was used. The samples tested were powdered shale ash (200 mesh) and FCC fine catalyst. The inlet velocities tested ranged from 10 to 26 m/s and the solid concentration was varied from 10 to 50 g/m^3.

Conclusion

1. With the increasing particle concentration, the separation efficiency for both kinds of particles increased and the pressure drop decreased. Significant discrepancies between the separation performances for the shale ash and catalyst powders were observed. The separation efficiency and the pressure drop of shale ash were both lower than that of the catalyst and the pressure drop decrease as a function of inlet shale ash concentration is greater than that of the catalyst.

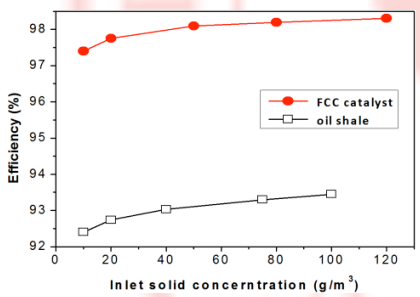

Figure 2 the relation between efficiency and inlet solid concentration

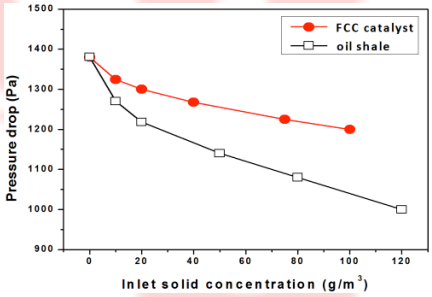

Figure 3 the relation between pressure drop and inlet solid concentration

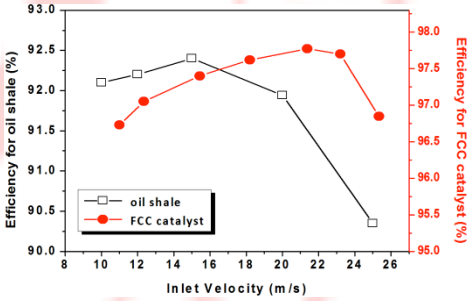

Figure 4 the relation between efficiency and inlet velocity

2. The inlet velocities with highest efficiency were insensitive to changes in solid concentration. For shale ash, this is 15 m/s, which is much lower than the FCC fine catalyst.
3. The differences in cyclone separation performance between the particle types is attributed to particle shape, particularly how spherical the particles are, which has a significant effect on the tangential velocity of the particles in the separator.
4. Currently, most cyclone separators used in the oil shale industry are the same as those in the Petro FCC industry, but due to significant differences in the nature of shale ash particles, alternative designs and operation parameters should be considered for cyclone separators used in the oil shale industry.

Figure 5 the shape of shale ash

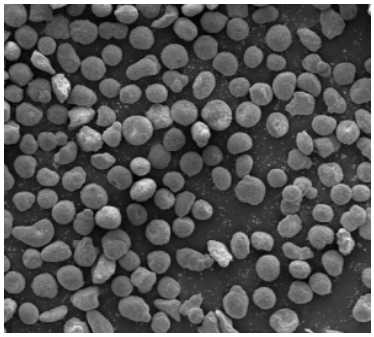

Figure 6 the shape of FCC fine catalyst