AIR POLLUTION RESEARCH AT THE ENERGY RESEARCH INSTITUTE

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Research activity at the ERI is centered around three broadly classified areas of interest, these being:

1. Alternative Liquid Fuels, notably alcohols and other coal derived fractions.

2. Solid Fuel Combustion, with an emphasis on fluid bed processes.

3. Technology for underdeveloped areas.

Interest in air pollution control has arisen as a result of activity in the first two areas, and a summary of specific projects in this field is given below.

1. Emissions from alcohol and alcohol/petrol blends.

This experimental investigation, conducted over the past five years, has looked at emission levels of carbon monoxide, total hydrocarbons, oxides of nitrogen, and total aldehydes, both from single cylinder test engines, and from a variety of passenger vehicles running on a chassis dynomometer under classic urban driving conditions.

Even under correct engine design conditions, aldehyde emission levels have been shown to be much greater with alcohol-based fuels than with petroleum-based products, whereas the other contaminants tended to decrease. The significance of this can be found in the assertion that aldehydes play a major role in the formation of photochemical smog.

This component of the research is currently being extended by a series of smog chamber studies, where the kinetics of photochemical smog formation will be identified.

2. Sulphur and Nitrogen Oxides Removal during Fluid Bed Combustion.

The very large quantity of high ash, high sulphur, fine coal, being stockpiled locally as a consequence of beneficiation, has prompted an investigation of alternatives to both grate and pulverised firing for large scale combustion units. Fluidised combustion has been shown to offer many advantages, among them being the ability for in-situ removal of sulphur and nitrogen oxides, by the addition of calcareous sorbents such as limestone or dolomite, and by control of the combustion temperature and atmosphere respectively.

Sulphur uptake is a function largely of sorbent physical properties. A wide range of local limestones and dolomites have been classified in terms of their porosity, effective surface area, granularity and compressive strength. New sorbent surface is generated continuously within the fluid bed by abrasion. The attrition mechanism has been described, and its influence on sulphur capture noted. Sorbent attrition further affects the size distribution of solid material within the fluidised combustor, and may consequently increase the amount of material carried out of the unit by the fluidising air stream. This increased dust burden places a greater demand on particulate removal equipment.

The interaction between sorbent behaviour and combustor operating parameters is complex and is the subject of a component – based model being developed at the ERI.

3. Particulate Clean-up using Granular Filters.

Atmospheric air quality is readily characterised by its dust and soot level. With the advent, too, of combined cycle hardware for electrical power generation, there is renewed interest in the field of particulate removal from combustion processes. Flue gas cleanup at elevated temperatures (in excess of those sustainable by typical fabric filters) is attractive because of the obvious energy gain. For this reason, granular filters, which offer the advantages of high temperature operation, low pressure drop, and high capture efficiency, enjoy a high research priority.

The ERI is experimenting with a moving granular panel filter for gas cleanup from fluidised combustors, burning either coal or biomass residues, including municipal solid wastes. Interest has centred on operation of the filter in a mode where filter granules are preserved in an essentially clean condition. This overcomes the problem of knowing to what extent dust deposition affects the transient behaviour of the filter, and preserves the inherently low pressure drop associated with this filter.

An economic analysis has shown the moving granular filter to be cost competitive with electrostatic precipitators, and to be more economical than fabric filters, regardless of equipment scale.

Further work is anticipated on the interpretation of the filter mechanism which is complicated by the continuous movement of the filter granules.

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