# A NewTest for Spontaneous Combustion Propensity utilising Microcalorimetry

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Materials such as coals, coal products (e.g., chars, briguettes) and activated carbons are a self-heating hazard in storage and transportation. Accordingly, work was carried out in the 1970's (1,2) largely at the Fire Research Station in the UK, which led to the formulation of a test (3,4) for predicting whether or not a particular coal or carbon material was a self-heating hazard. The test wich is very widely used up to the present time, focuses on the quantity *critical ignition temperature*, and the present author has shown (5) that this is not the most suitable quantity around which to build such a test. The critical ignition temperature provides an indication of self-heating hazards only in the limit where all susceptible materials have the same activation energy (usual symbol E, units J $mol^{-1}$) for their reaction with atmospheric oxygen. This is very far from the truth, and consequently the tests are unreliable.

A better quantity around which to establish a criterion for thermal safety is the *heat-release rate at criticality*. In reference (6), the author has established the theoretical basis of this and applied it to activated carbons of various manufacturing histories, some of them with significant self-heating propensity and some of them with little if any. It is shown that if such a material is to be shipped or stored in bulk quantities of 3m cube (i.e., 27 $m^3$) at ambient temperatures of 38°C or lower, it is not hazardous provided that its rate of heat release at that temperature does not exceed $2 \times 10^{-3}$W $kg^{-1}$. This figure is easily adapted to other sizes and ambient temperatures using the theory set out in reference (6).It can also be extended to materials other than activated carbons using appropriate thermal conductivities and calorific values.

Clearly microcalorimetry is suitable for implementation of this approach, and a Thermometric 2277 instrument was used in measuring heat-release rates by the activated carbons for comparison with the the threshold value of $2 \times 10^{-3}$ W $kg^{-1}$. Theory and application are both quite specialised, and a reader of this note wishing to pursue the method will need to consult the original account (6) or, alternatively, contact the author. In Table 1, below, we present results for three of the carbons studied.

This concept of heat-release rate at criticality, and its implementation using the Thermometric 2277 instrument, represent both a significant advance in the prediction of spontaneous combustion hazards and a new avenue for the application of microcalimetry in industrial practice. The author will be pleased to give advice on applications to particular materials.

**Table 1. Heat-release rates at 38°C of three activated carbons, taken from (6)**

| Carbon description | Heat release rate at 38°C/W $kg^{-1}$ | Safe, unsafe or critical at 38°C |
|---|---|---|
| Finely milled chemically activated carbon | $2 \times 10^{-2}$ | Unsafe |
| Steam activated carbon, acidified nin processing | $2 \times 10^{-2}$ | Critical |
| Peat-based steam activated carbon | $1 \times 10^{-3}$ | Safe |

## REFERENCES


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