Chapter I

Introduction

In principle, any combustible solid materials can be made to burn if a source of ignition is applied. When the materials are divided into small pieces of fragments and then into powders or dusts, they become more easier to ignite and to burn more rapidly in the air as their surface areas increase. The particulate matters, when dispersed in air at a suitable concentration and in the presence of an effective ignition source, are explosible similar to that of homogeneous combustible gas mixture.

Particulate matter may be produced as the final product as in agriculture or food, chemicals, plastics, pharmaceuticals, metals and fuels like coal or wood. Alternatively, they may be produced as by-products such as textile fluff, wood sawdust and dust from the processes in which solids are polished, cleand or cut. Attention should be paid even to these waste dusts, if they are combustible or contain any kinds of flammable matters. Several vigorous dust explosions have been encountered in refuse shredders at municipal incinerator plants in Japan, in which a dust bag of dumped aluminium has been treated without notice.

Along with progress in powder technology, there has been an increasing demand for the manufacture of materials in a powdered form. Modern high technologies also require more fine (or ultra-fine) particles of new materials, for an example, such as magnetic alloy of rare-earth metals, having high ignition risk in contact with air. The majority of combustible particulate matters are generated, handled and stored in industrial settings, where the potential hazard of dust explosion has recently been increased with enlargement of plant scale and with increase of powder processes.

Explosions became the problem around which one's professional life might develope with great success. Whoever is confronted with dusts, be it the field engineer or the scientist, should benefit from this thesis and increase the safety of the facility for which he/she is responsible.

The aim of this work is to carry out the development and construction of a Dust Explosibility Tester. The effect of the particle size of some dust samples on the Lower Explosion Limit (LEL) is examined. Finally, a brief guideline on how to prevent dust explosions and fire problems in an industrial plant is suggested. The results for certain dust samples found in domestic industries that have been studied abroad will also be summarised for reference.

1.1 Objectives of the Present Study.

1.1.1 Design and construct a Dust Explosibility Tester

1.1.2 Improve and modify the Dust Explosibility Tester until it yields results close to standard testing results.

1.1.3 Study the influence of the particle size of dust samples on the Lower Explosion Limit (LEL)

1.1.4 Prepare guideline on how to prevent dust explosions and fires in an industrial plant.

1.2 Scope of Work.

1.2.1 Literature review

1.2.2 Design and construction of a Dust Explosibility Tester

1.2.3 Improvement of the Dust Explosibility Tester, for example, by

- adapting the air flow channel between the dust cup and the mushroom like umbrella
- adjusting the distance between the sparking electrodes
- varying the spark delay time

1.2.4 Studying the influence of the particle size on the LEL by varying the particle size of dust samples in the range of less than 45 μm to 180 μm as well as by

- Investigation of the LEL as mentioned in the Standard Testing Method
- Characterizing the particle size distribution of dust samples by using Standard Sieve measurements or Photo Sizer measurements