PARTICLE SIZE CHARACTERISTICS OF A PALM OIL MILL BOILER FLYASH

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presented at:

Seminar on : Modern Method of Particle Characterization - Size Analysis & Zeta Potential

19hb. November, 1987

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ABSTRACT

A size distribution measurement of a palm oil mill fly ash samples collected at the stack exit downstream of a mill boiler was made. Results show that the geometric mean particle size was between 1.28 to 1.68 micron. Almost 90% of the fly ash falls well below 4 μm size diameter and this could pose potential health hazard since these particles are in the respirable particulate size region. Other significant characteristics of the fly ash particulate are further discussed in this paper.

INTRODUCTION

Suspended particulate matter introduced to the environment from fuel combustions, incineration and industrial emission sources are causing increasing concern to air pollution researchers. Particularly, most of the particulate emissions are in the submicron sized particles which could pose inhalation threat to man and animals. This may also affect the meteorological and geophysical set up such as the scattering of solar radiation back into the space and reducing visibility. Therefore, a palm-oil mill plant operation is not an exception in this regard.

Presently, there are about 200 palm-oil mill plants found in this country and each mill is equipped with 2 boilers and one incinerator.[1] On average, 20 tons or more of both fiber ans shells are produced per 100 tons fresh fruit bunches processed and these are usually consumed in the mill as boiler fuel. Thus, the situation will certainly create a great burden of flyash particulate emission if it is not properly controlled. The boiler exhaust emission (without controlled) for the whole plant is estimated to be 26.4 tons/base on one hour operational time alone. Therefore, the study on the size characteristics of palm oil mill flyash is warranted.

METHODOLOGY

Sample collection.

The stack flyash samples were obtained from a mixed fiber and shell fired-fuel palm-oil mill which has the capacity of processing 20 tons of fresh-fruit bunches per hour. The mill is equipped with 2 boilers (one as standby) and one unit of multicyclones dust collector. The stack flyash was collected isokinetically using portable Anderson Universal stack sampler. The sample was dried in an oven for at least 48 hours before the size analysis. Detail of the sampling procedures and description of the sampling equipment are given elsewhere.[2]

Size Analysis.

The flyash size distribution was measured using Micron Photo Sizer, MPS (Seishin SKC-2000). The operating principles of the MPS is based on the photo-extinction phenomenon and the Stoke's Law sedimentation theory. The method measures almost any particle size distribution rapidly with good accuracy. The system is fully computerised and the results are printed-out on a hard copy. Detail description of the MPS and the experimental procedure are given in reference.[3]

RESULTS & DISCUSSION

As many as five size measurements were made for the stack flyash samples and these are given graphically in the log-probability plot (figure 1). Experience shows that many dust samples are log-normal and since the points obtained in this study are rolatively straight on the plot, the flyash particles size distribution also follow the same pattern. A sample MPS output for one of the analyses is enclosed at the end of this paper.

The slope of the line representing data on the log-probability plot is a measure of the geometric standard deviation, σg and this is found by:

$$\sigma_g = \frac{d_{84.1}}{d_{50}} = \frac{d_{50}}{d_{15.9}}$$

where $d_{15.9}$, d_{50} and $d_{84.1}$, are the diameters on the cumulative curve where the cumulative percent are 15.9, 50 and 84.1 respectively. As shown in Figure 1, the σg for the flyash ranges from 1.58 to 1.77 micron.

While the geometric mean diameter ranges from 1.28 to 1.68 m. The results seem to be consistent i.e. within a very small range. A vast majority of the particles are in the fine size fraction, and it is not impossible that the MPS has difficulty in quantifying the particle size distribution. Nevertheless, 90% of the flyash are below 4 μm size diameter and this is considered to be in the respirable size region. Unfortunately, this may pose a potential health hazard, the mill workers particularly. These fine particles are retained in the air for quite sometimes before settling to the ground.

Based on this finding, the average approximate terminal settling velocity of the particulates will be 0.01 cm/s. Considering if there are no plum rise and turbulent effect from the surrounding, the particles will take approximately 7 days to settle to the ground based on the physical height of the stack alone!

CONCLUSION

The studies on the measurement of the particulate size distribution of a palm oil mill boiler stack flyash has been reported. The geometric mean diameter was found to fall between 1.28 - 1.68 micron ~~which indicates that~~ majority of the particles are in the respirable particle size region. Thus, a more coincise and symatic approach of quantifying possible health effect pose by these particles need to be scrutinized.

Acknowledgements.

The authors wish to thank Harrisons Malaysian Plantations Berhad for giving the permission to publish this work.

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