

LIDAR OBSERVATION OF STACK PLUME

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ABSTRACT

For the observation of the smoke plume exhausted from a high stack a PPI-RHI lidar capable of quick scanning is more desirable than an A-scope lidar from the point of view of the rapid change of plume. A few examples of analyses will be given here for the plume observation made by a PPI-RHI lidar.

Since the instantaneous cross-section of plume is very irregular with clear boundary on the whole, we made full use of what we call the spatial running average for smoothing the cross-section along the distance downwind. The concentration distribution of smoke is thus obtained both in the crosswind (y-axis) and in the vertical (z-axis) direction at various distances, as is shown in Fig. 1. The coordinate of plume axis (\bar{y} and \bar{z}) and the plume width (σ_y and σ_z) are given by the concentration distribution.

It is found that the meander or wave pattern of plume is often significant as seen from the variation of \bar{y} and \bar{z} , and that the smoke dispersion is generally caused by not only the turbulence but

the meander of flow. This is taken into consideration in the evaluation of σ_y and σ_z in Fig. 2. The rates of change of σ_y, σ_z and σ_y/σ_z with the distance downwind are found useful to characterize the atmospheric dispersion, and the situation shown in Fig. 2 corresponds to the C~D category in the Pasquill-Gifford classification.

The observation used above was made under the condition of sea-breeze. The shape of the concentration distribution along the z-axis in Fig. 1 and the rate of change obtained from Fig. 2 both suggest the slight increase of the ascending flow of convection or the atmospheric instability with the distance downwind, that is, the distance from the sea.

Smoke flow is naturally influenced by the terrain, even if the stack concerned is high above the ground. Significant descent of plume was often observed near a river in the case of strong wind (7~11 m/s or more), though the side slope of river is rather gentle. This is verified to correspond to what is called the surface high pollution in strong wind in this area.

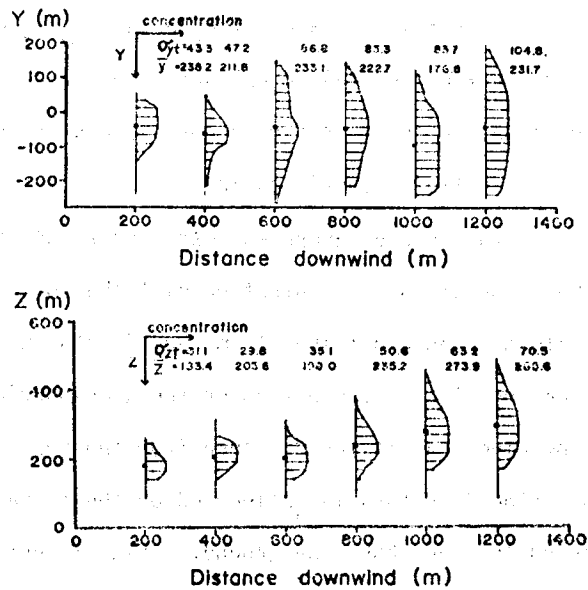


Fig. 1 The concentration distribution of smoke against the distance downwind.

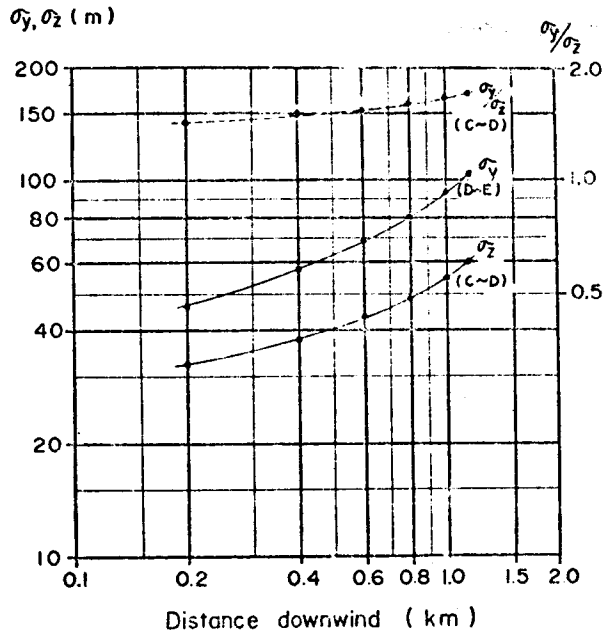


Fig. 2 σ_y , σ_z and σ_y/σ_z against the distance downwind.