Temporal and Spatial Distributions of Particulate Matters under Two Coal Mining Methods in Arid Desert Region of Northwest China

Ruoshui Wang\textsuperscript{1} and Yun Liu\textsuperscript{2}
\textsuperscript{1}Beijing Forestry University, School of Soil and Water Conservation, China (l907y254_g@163.com)
\textsuperscript{2}Beijing Forestry University, School of Soil and Water Conservation, China (675872919@qq.com)

Abstract: The particulate matter (PM) in coal mining can bring pollution to the surrounding environment and have adverse effect on human health. In order to prevent and control the PM pollution in coal mine and better understand the PM transportation in the air, spatial and temporal distribution of PM concentration in two typical coal mining methods were studied in the arid desert region of northwest China. The mass concentrations of particulate matters, i.e., PM1, PM2.5, PM10 and TSP (total suspended particulate), were monitored by portable environmental particulate matter meter during two windy seasons—spring and winter in a typical opencast coal mine and an underground coal mine. The results show that:

(1) In the opencast mine, high concentrations of PM appeared in the mining area (MA). Average PM10 and TSP concentration were 1950.18 μg·m\(^{-3}\) and 2393.56 μg·m\(^{-3}\) respectively in spring, while PM1 and PM2.5 concentration were 6.22 μg·m\(^{-3}\) and 42.58 μg·m\(^{-3}\) in winter. In the underground mine, it was concentrated in the coal yard (CY), average PM10 and TSP concentration were 920.95 μg·m\(^{-3}\) and 1225.89 μg·m\(^{-3}\) respectively in spring, while PM1 and PM2.5 concentration were 8.64 μg·m\(^{-3}\) and 35.93 μg·m\(^{-3}\) in winter.

(2) The variations of pollution index (PI) showed similar patterns in both spring and winter—that is, high in the morning then achieved maximum value exceeded 10, and decreasing from noon at the opencast mine entrance (ME), the mining area (MA), road in the mine (RM), and the coal storage yard (CS). However, the PI rose in the evening in spring, but decreased in winter. In the CY of the underground mine, the PI was high during the day; whereas in the evening it decreased in spring and increased in winter.

(3) In the opencast mine, the PM10 and TSP concentrations varied more obviously from season to season and from area to area than the concentrations of PM1 and PM2.5. Barometric pressure had the most significant influence on PM1, PM2.5 and PM10. Wind speed had the greatest influence on TSP. In the underground mine, the variation patterns of the concentration of the four different-sized particulate matters were basically the same from area to area. The concentrations of PM1 and PM2.5 had greater seasonal variation than PM10 and TSP. The most important meteorological factors were temperature and barometric pressure for PM1 and PM2.5, while air humidity had the greatest impact on PM10 and TSP.
Considering the above results, it is recommended to control the daily occurrence and spread of particulate matter at 08:00 and 18:00 in the opencast mine, and from 08:00 to 16:00 in the underground mine. Primary attention should be given to the influence of wind speed and relative humidity changes on the diffusion of coarse particles (PM10 and TSP) in spring, while the influence of changes in barometric pressure on the diffusion of fine particles (PM1 and PM2.5) should be considered in the mining area in winter for both the two typical coal mining methods. The diffusion of coarse particulate matter in the opencast mine and of fine particulate matter in the underground mine are the main issues to be considered, while it is essential to prevent and control the spread of fine particles in the areas of roadways.