USE OF RADIATION ABSORBING MATERIALS FOR CLEARING SNOW IN MOUNTAINOUS AREAS

H. D. SHARMA

Defence Science Laboratory, Delhi

(*Received* 24 *October* 1969; *revised* 10 *November* 1971)

A comparative study of melting of snow by spreading different materials such as charcoal powder, boiler ash, saw dust and common salt etc. on its surface under exposure to natural solar radiation has been made. The observations were carried out at Gulmarg at a height of about 9,000 ft. above sea level in the months of January, February and March 1965. It was observed that with the help of boiler ash, the melting rate of snow was increased to about 4½ inches per day which is about twice the rate without boiler ash. This material therefore seems to be very much suited to snow clearing operations in the mountain terrain.

The rivers in Arctic regions are frozen during winter but the flow continues under the ice. In the snow bound areas the roads are closed for about five months due to snow fall. This results in transportation troubles for the services. Studies were carried out by spraying black materials on roads to hasten the melting of snow by solar radiations. The studies were made for agricultural areas also.

EXPERIMENTAL PROCEDURE

A special snow gauge was used for the accurate measurement of the precipitation at Gulmarg (Lat 34°, 03N, 74°, 34E) where snow fall is very heavy from December to April. The gauge consists of a cylindrical receiver (8 in. dia and 2 ft. in length) mounted on an iron stand at a height of 5·5 ft. above the ground and provided with wind-shields. After the snow fall, the receiver was removed from the wind-shield. The amount of precipitation was calculated by adding known amount of hot water and measuring the final amount. The depth of snow was measured with snow poles. The water equivalent of snow was determined. The sunshine hours were recorded with the help of Chamball sunshine recorder. The same procedure was applied as reported earlier for measurements of the other meteorological data such as temperature humidity and sky conditions.

Snow melting was commenced on 15th January 1965 by utilization of solar energy in front of the Field Laboratory, Gulmarg. Fourteen fields (15 ft. × 15 ft.) were selected but the results reported here are only for four fields. Different materials such as common salt, saw dust, charcoal powder and boiler ash alone as well as in different combinations were used. The quantity of each material used for each field is tabulated in Table 1. The different materials were spread over the fields after every fresh snow fall. The depth of snow was measured daily along with the meteorological data. On the basis of the above work, two more fields were selected and only charcoal powder and boiler ash were spread on a width of 8 in. strip and the distance between the two adjacent strips was kept 2 ft. Five such lines of each material were formed. In the third experiment, all the three materials were spread in thin lines where the distance between two adjacent lines was kept only 1 in. It was found that after the snow fall, the strips were not visible and therefore the method was discarded. In the fourth experiment, the same observations were made on the different slopes of 1/10 and 1/20 gradients.

RESULTS AND DISCUSSIONS

There are two immediate sources of radiation (i) direct from the sun and (ii) from the sky or diffuse radiation. Both supply heat to the snow cover in amounts that vary much from day to day and also vary according to location and elevation of the snow. On cloudy days there is practically no direct radiation and sky radiation may be reduced to nearly nothing. On the other hand, on bright sunny days the effect of radiation on the snow cover is great and snow washes away rapidly under a clear sky. It is seen that the maximum melting of snow was when the sky was clear and the sun was bright. The effect of radiation is greater as elevation increases. The snow reflects radiant energy at a high rate, the albedo varies from 60 to 90 per cent. The portion of radiant energy that is effective in melting snow is

TABLE 1

QUANTITIES OF VARIOUS MATERIALS USED FOR CLEARING SNOW IN AN AREA OF 15 ft. × 15 ft.

Materials used	Quantity in gms.
Charcoal powder	500
Charcoal powder and Salt	(250 + 250)
Charcoal powder, Salt and Saw dust	(250+250+250)
Charcoal and Saw dust	(250+250)
Charcoal in lines	250
Common salt	500
Saw dust	500
Boiler ash	500
Wood ash and Saw dust	(250+250)
Ash and Common salt	(250+250)

that part which is absorbed and is limited to 10 to 40 per cent, dependent upon the condition of the upper layer of the snow. The results show that when a very thin layer of charcoal powder and boiler ash was spread on the surface of the snow, on an average the melting rate increased to nearly 60 in. in the month of January and February and approximately 100 in. in the month of March, while without the black materials, the melting of snow was 30 in. in the months of January and February and 45 in. in the month of March under similar conditions of weather. Moreover the absorption by boiler ash and charcoal powder varies from 70 to 90 per cent. From the trials of the different materials, they can be put in the following descending order of merit based on their efficacy for melting of snow:

Charcoal Powder, Boiler Ash, Wood Ash, Saw Dust, Common Salt.

It is worthwhile to mention here that if the charcoal is available in the fine grain size, it would give the best results and the quantity required would be very small. But from the economical point of view, the boiler ash will serve the purpose. It was seen that the snow completely vanished on 13th March, 1965 from the field in which the charcoal powder was used, whereas, other fields were covered with snow and the depth of it varies from 8 in. to 4 ft. It was also observed that the efficacy of melting of snow was much better with uniform spreading over the whole area than with spreading along the lines when the boiler ash was spread evenly. The total melting of it recorded was 58 in. from 25th February to 14th March, whereas in the case of lines under the similar conditions it was only 45 in. This may be due to the fact that half of the portion in the case of lines was under shadow except a few hours during the day. It was also observed that the melting of snow was faster on the slopes than on the uniform ground. The melting on a gradient of 1/10 was more than the gradient 1/20.

The studies would be more useful if the experiments are carried out on the slopes. The snow covered roads can be cleared off by the machines but the snow on the slopes which is the main cause of land slides, is not possible to remove it by the existing appliances. Therefore it would be advisable that as soon as the snow clearance operations are commenced for clearing the roads, the boiler ash should be spread on the slopes to avoid the land slides. In this fashion the roads in the mountain terrains which are covered with snow can be opened at least two months earlier without any difficulty and much expenses. It is suggested that further work should be carried out under the controlled conditions at different stations alongwith the necessary meteorological data to determine the exact quantity of ash required, the proper time, and the method of spreading the ash over the snow covered slopes.

ACKNOWLEDGEMENTS

I am grateful to Shri R. S. Sharma and especially to my wife who rendered their full co-operation and help during the progress of the experimental work at Field Laboratory, Gulmarg.