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Remarkable Changes in Index Properties of Soil Due To Stubble Burning

Karamjit Kaur, Tarun Kumar Lohani

***Abstract*— Burning stubble has created a panic like situation among environmentalists. The concern does not restrict to environmental degradation but also has put the geoscientists to think of the issues related to low fertility and drastic change in the engineering properties of soil. To find the major changes in the engineering properties, the issue has been taken up at large. Three different locations have been randomly selected in a village of Tarantaran district of Punjab bordering Pakistan. Soil samples were collected at the instance of pre burning and post burning period of stubble. Different index properties like liquid limit, plastic limit, optimum moisture content, specific gravity and sieve size analysis were studied. During the study it was surprisingly found that most of the properties are significantly reduced. The analyses of soil samples have shown a decline of specific gravity from 2.6 to 2.37. The liquid limit changes by 2.34 whereas plastic limit changes by 3.2.**

In this study some remarkable changes were also noticed before and after stubble burning, Optimum moisture content decreased in all the areas whereas specific gravity also decreases in two of the areas. The liquid limit and plastic limit also decreases in all the areas. This implies stubble burning influences the index properties of soil on the whole.

***Index Terms*— Stubble, index properties, liquid limit, plastic limit, specific gravity and optimum moisture content**

I. INTRODUCTION

Remnants of crop after harvesting known as stubble, is a major concern for the environmentalists. People of Northern India mainly Punjab, Haryana and Rajasthan feel it easy and comfortable to burn the stubble rather than to recycle making their farming land for the next crop. After harvesting paddy crop large quantity of paddy straw is left that makes farmers too difficult to store. This stubble after the crop is found to be of no use, hence they prefer to burn them. This has become day to day practise for the farmers to go ahead and for their convenience they go on burning without ascertaining that it pollutes the entire environment. In Punjab this is a major issue in these days. Stubble burning pollutes the environment. It affects the water, air as well as soil. Soil, mostly gets affected during stubble burning reducing the nutrient budget. Stubble burning also influences the index properties of soil at a large (Arora, 2008; Gadzama, 2016; Noraini, 2008).

II. METHODOLOGY

Three different locations were collected from three farming areas apprixamately 100 m. Apart so as to produce a diversified result. The soil samples were collected from the villages named Mari KambokeofTaranTaran district (Fig.1).

Fig.1 Location Map of the samples collected (Source: Google Earth)

Soil samples were collected before and after stubble burning from the three different areas. Six samples were collected during this study. Samples were collected from a depth of 3feetand were kept in poly bags before getting them airtight so as to avoid any water loss from the samples. After collection of samples, soil tests were performed. Index properties like liquid limit, plastic limit, specific gravity, optimum moisture content and particle size analysis were done in the laboratory of Universal Institute of Engineering & technology, Lalru, Mohali.

It is important to notice that the areas from where soil samples were collected are hardly affected by meteoric water as the rainfall data in Table 1 shows a scanty rainfall. This gives a rough conclusion that the climate in this area is cold and semi arid. Since the soil has a slty complex, the characteristic may be clayey in nature and the mineralogy may be montmorillonite. This type of soil is usually generated from is a very soft phyllosilicate group of minerals that form when they precipitate from water solution as microscopic crystals.

Average rainfall of five consecutive years from 2014 to 2018 is presented below in Table 1 which shows the soil holds sufficient volume of water indicating high porous in nature and less permeable by which the bore wells drilled in those areas go up to 200m and above. The thick clay and sandy clay zone over rides the sandstones showing a long term river deposit for some centuries. Scanty rainfall indicate very less leaching on soils and increase the fertility of the soil since possibility of minerals draining out is rare due to heavy rainfall.

Table 1 Average rainfall data for 5 consecutive years (2014-2018)

Months	Average Rainfall in mm
JAN	13
FEB	25
MAR	19
APR	6.8
MAY	11.8
JUN	35.5
JUL	93.1
AUG	84.4
SEP	34.4
OCT	0
NOV	0
DEC	5.5
TOTAL	328.5

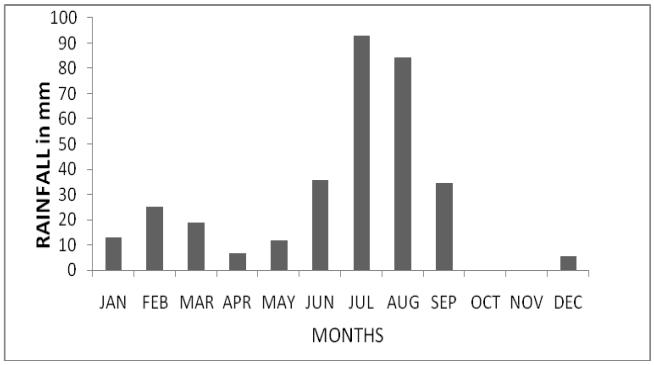

Fig.1 Average Rainfall graph from 2014-2018

III. RESULT:

SPECIFIC GRAVITY

Specific gravity of all the samples were determined as per IS: 2720, part III: Sec:1980.In this study specific gravity were tested six times for six areas. From Table 1.1 it is clear that specific gravity has decreased from pre to post burning. The detailed report has been presented in Table 2.

Table 2 Results of the Specific Gravity of the study areas

AREA	BEFORE	AFTER
1	2.33	2.04
2	2.59	2.28
3	2.88	2.84
Average	2.6	2.37

LIQUID LIMIT

The liquid limit of soil was determined using the help of Casagrande' s Apparatus as per IS: 2720,part 5:1985.The result presented in table 3 represents a marginal decrease in Liquid limit in all the three areas.

Liquid limit

Table 3 Results of liquid limit of the study areas

AREA	BEFORE	AFTER
1	22.5	20
2	20	19.5
3	22.5	18.5
Average	21.67	19.33

PLASTIC LIMIT

The plastic limit of soil samples were calculated as per IS 2720, part 5:1985.After stubble burning plastic limit has declined as compared to before stubble burning. Plastic limit found in all the areas shown in the following table

Table 4 Results of the plastic limit of the study areas

AREA	BEFORE	AFTER
1	20	15.38
2	14.28	11.11
3	17.64	15.83
Average	17.31	14.11

OPTIMUM MOISTURE CONTENT

Table 5 shows the optimum moisture content of soil samples. The tests were conducted as per IS: 2720, part 11 1973 sec 1. Sharp decline in the results are clearly marked in the table.

Table 5 Results of the optimum moisture content of the study areas

AREA	BEFORE	AFTER
1	17.64	11.11
2	11.11	10.31
3	14.79	12.23
Average	14.51	11.22

GRAPHICAL CALCULATIONS OF THE INDEX PROPERTIES

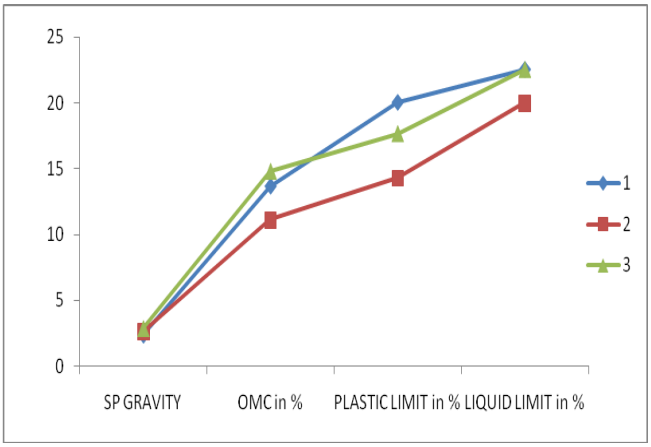

Fig.2 Graphical representation of index properties of the three study areas before stubble burning

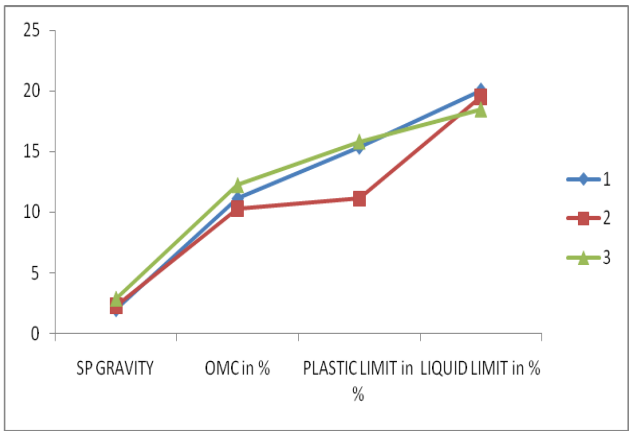

Fig.3 Graphical representation of index properties for three areasafter stubble burning

PARTICLE SIZE ANALYSIS

The particle size analysis was done according to IS 2720, Part IV:1985. The particle size distribution curve is plotted between particle size(in mm)as abscissa on log scale and percentage fine as (%) as ordinate. The particle size curve for all the six area before and after stubble burning is given below.

Table 5 Results of the Uniformity Coefficient of the study areas

AREA	Uniformity Coefficient before stubble burning	Uniformity Coefficient after stubble burning
1	22.5	11.82
2	7.56	16.9
3	15.56	13.1
Average	15.20	13.94

Table 6 Results of the Coefficient of Curvature of the study areas

AREA	Coefficient of Curvature before stubble burning	Coefficient of Curvature after stubble burning
1	0.001	0.0086
2	0.0076	0.02
3	0.041	0.006
Average	0.016534	0.011534

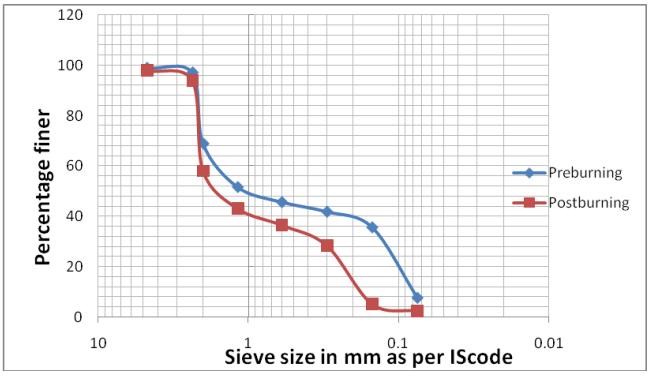

Fig.4 Graph of particle size distribution before and after stubble burning of Area1

Pre burning

- Uniformity Coefficient, C_u =22.5,Coefficient of Curvature, C_c=0.001

Post burning

- Uniformity Coefficient, C_u = 11.82, Coefficient of Curvature, C_c =0.0086

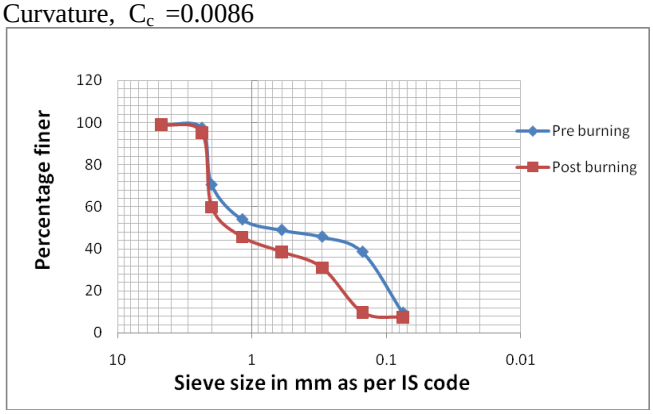

Fig.5 Graph of particle size distribution before and after stubble burning of Area 2

Pre burning

- Uniformity Coefficient, C_u = 7.56 ,Coefficient of Curvature, C_c =0.0076

Post burning

- Uniformity Coefficient, C_u = 16.9 , Coefficient of Curvature, C_c =0.02

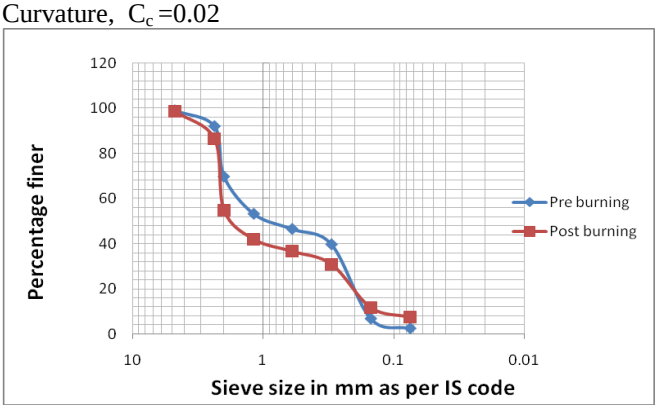

Fig.6 Graph of particle size distribution before and after stubble burning of Area 3

Pre burning

- Uniformity Coefficient, C_u =15.5 , Coefficient of Curvature, C_c =0.041

Post burning

- Uniformity Coefficient C_u =13.1, Coefficient of Curvature C_c =0.006

IV. CONCLUSION

From the pre and post burning graphs it is clear to predict that burning hardly affects thye specific gravity of the soil samples. The same characteristic properties are found in case of optimum moisture content, but surprisingly post burning provides a significant change in plastic limit as well as liquid limit. One interesting fact is note regarding liquid limit is that there are different values in pre stubble burning but in post burning case all the three sample show a nearly same value. Sieve size analyses of the samples are too interesting to note down. Both the graphs do not have much variation in the beginning but subsequently they vary a lot but in the later stage the graphs go on converging. This shows a more or less diagnostic state of index properties. Ultimately it can be finally concluded that stubble burning does not have too much impact on index properties but the results are quite remarkable and distinct for a gentle decline.

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Karamjit Kaur, M Tech Scholar, Uiet (Mohali)
Prof. (Dr.) Tarun Kumar Lohani, Director Engineering Uiet (Mohali)