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UTILIZATION OF MARBLE SLURRY TO ENHANCE SOIL FERTILITY AND TO PROTECT ENVIRONMENT

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ABSTRACT

Rajasthan is a rocky state having oldest Aravali ranges, which are very rich in diverse minerals, particularly dolomite, granite and marble. Hence, so many industries in Rajasthan are based on these rocks. However, during mechanical processing of these minerals, about 30%-40% part is left as a waste in the form of slurry. These mineral wastes could be used as a source of macro and micronutrients for soil. XRF analysis was done to evaluate the composition of marble slurry. Result of XRF revealed that 30.52% of calcium, 9.95% of magnesium, 1.57% of iron, 0.05% of potassium, 0.09% of phosphorous and 0.07% of manganese present in it. XRF analysis of marble waste also showed the presence of ultra micro nutrients and REEs (Rare Earth Elements). It is found to be an effective combination to provide macro and micro nutrients for soil.

KEY WORDS: Minerals, macronutrients, micronutrients, XRF analysis, rare earth elements

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INTRODUCTION

Natural resources that we use from the environment have an environmental cost, which is the hidden cost of environment damage and repair, while the raw material is processed from the earthy resources, other than their economic costs. Rajasthan being a rocky state, is rich in diverse minerals, particularly dolomite ($CaMg(CO_3)_2$),marble ($CaCO_3$), and granite (a mixture of micronutrient minerals). The ever increasing popularity of the marbles of Rajasthan, the growing demand for finished and unfinished products and discovery of new marble deposits have led to a significant growth in marble industry of this state. There is also a simultaneous rise in waste generation as well. About 360 marble quarries are operational in this state. During mechanical processing, about 30%-40% is left out as waste in the form of powder or slurry [1]. As in common practice, manufacturers dump this waste material over the nearby wasteland areas. The heaps of this waste material acquire large land areas and remain scattered all around, spoiling the aesthetics of the entire region and have affected tourism and industrial potential of the state [2]. This is an obvious threat to the environment and holistic development.

Effect on environment

The amount of marble slurry generated in Rajasthan every year is substantial, being in the range of 7-8 million tones. Most of the solid waste is dumped on land in heaps in uncontrolled manner. Disposal of these wastes imposes hazardous impact on the environment. The marble slurry imposes serious threats on ecosystem, physical, chemical and biological components of environment [3].

Problems encountered are:

1. The waste is indestructible.
2. When dumped on land, it adversely affects the productivity of land due to decreased porosity, water absorption, water percolation etc.
3. The heaps of slurry, that remain scattered all around the industrial estate are an eye sore and spoil aesthetics of entire region. Subsequently, tourism and industrial potential of the state are adversely affected,
4. During the rainy season, the slurry is carried away to rivers, drains, roads and water bodies affecting quality of water, reducing storage capacities and damaging aquatic life.
5. Contamination of air due to fine particles. (Size is less than 363 micron)
6. Public outcry due to general losses[4].

Soil re-mineralization may have the potential to contribute in reducing carbon in our atmosphere by increasing the potential to lock more carbon into soils and biomass. By co-utilizing rock dusts with composted organic wastes to create alternative soil fertility systems, we could maximize the value added market potential for the composts in areas of large scale usage such as agriculture, thus avoiding the environmental and social impacts of land filling these wastes[5,6].The objective of this work was to evaluate the potential of marble waste for its reclamation in diverse forms and the usefulness of marble waste to protect our environment. Authors have studied the chemical composition and potential of this mineral waste as soil nutrient, so that we can serve the cause of bio friendly sustainable development by way of reclamation of these soil pollutant mineral wastes in the form of fertilizer.

MATERIALS AND METHODS

Wastes of marble industry used in the present study have been procured from local industrial areas of Alwar, Rajasthan. Marble slurry was air dried and powdered. An elementary chemical analysis was done by X-Ray Fluorescence spectroscopic technique (XRF) at Advanced Instrumentation Research Facility (AIRF), Jawaharlal Nehru University, New Delhi. In XRF, X-rays produced by a source irradiate a sample. The elements present in the sample emit fluorescence radiations with discrete energies, which are characteristic of these elements. The type of elements present can be determined by measuring the intensities of the emitted energies in the sample.

RESULTS AND DISCUSSION

While pulverizing or polishing marble, unused powder or slurry comes out as wastes. An elementary chemical analysis by XRF revealed that this waste material have an immense potential as source of macro and micro nutrients of soil. The analysis of industrial waste also showed the presence of ultra micronutrients and REEs. The Marble slurry can be used as a soil nutrient.

Table 1(a)
Chemical analysis of marble slurry

Component	% of weight
SiO_2	3.22
Al_2O_3	0.97
Fe_2O_3 (micronutrient)	1.57
CaO (macronutrient)	30.52
MgO (macronutrient)	9.95
Na_2O	0.06
K_2O (macronutrient)	0.05
MnO (micronutrient)	0.07
TiO_2 (REE)	0.03
P_2O_5 (macronutrient)	0.09

Table 1(b)
Chemical analysis of marble slurry

Component	Weight (ppm)
Ti	111.25
V	2.28
Sr	25.13
Zr	5.70
Pr	25.20
Yb	66.50
W	36.07
Th	2.06

Marble slurry is a good source of calcium and magnesium with 30.25% of Ca and 9.95% of Mg in it. Calcium ions with positive charges help build good soil structure by acting as “bridges” that bind negatively charged clay particles together[7]. Magnesium ions are similar to calcium ions with two positive charges. Magnesium is the central atom in the chlorophyll molecule required for photosynthesis. Potassium plays many essential roles in plants. It is an activator of dozens of enzymes responsible for energy metabolism, starch synthesis, nitrate reduction and sugar degradation. It helps regulate the opening and closing of stomata in the leaves and uptake of water by root cells. Potassium increases crop resistance to certain diseases by encouraging strong root and stem systems[8]. Iron acts as electron carrier in enzyme systems that bring about oxidation-reduction reactions in plants. It plays important role in chlorophyll formation. Manganese is essential in photosynthesis, nitrogen metabolism and nitrogen assimilation. Phosphorous is essential for plant growth. It plays a critical role in the life cycle of plant and essential for numerous metabolic processes. It is a component of adenosine di phosphate (ADP) and adenosine tri phosphate (ATP), the two compounds involved in most significant energy transformations in plants[9]. According to recent researches, Rare Earth Elements (RREs) and ultra micro nutrients can regulate absorption of other mineral elements to the plants[10]. They stimulate the uptake of calcium in plants. They affect the activity of some enzymes and

phytohormones, thus increasing the intensity of photosynthesis[11]. Favorable effects of REEs on seed germination have also been observed[12, 13].

CONCLUSION

The use of marble wastes as part of holistic soil improvement may also be referred to as re-mineralization when application of quarry wastes can reintroduce minerals lost through weathering and intensive crop production. This suggests that marble waste is potentially valuable as a soil amendment.

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