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Advances in Applied Science Research, 2016, 7(1):81-84

ISSN: 0976-8610
CODEN (USA): AASRFC

Use of Kota stone waste to ameliorate the soil fertility and to alleviate environmental hazards

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ABSTRACT

Rajasthan is characterized as the home to inexhaustible sources of various types of dimensional stones which include marble, granite, lime stone and Kota stone. Kota stone industry is one of the well-known industries of Rajasthan. The increasing demand of Kota stone in various purposes has led to the generation of large amount of waste during mechanical processing in the form of slurry and solid waste. Improper waste disposal has caused land degradation, loss of aesthetics, pollution, health and safety hazards consequently recycling of industrial wastes and by products is becoming a crucial demand by the environmental laws in agreement with the concept of sustainable development. Kota stone waste contains many organic and inorganic materials which can be transformed into certain useful, valuable and more accessible forms. The chemical analysis of Kota stone waste was carried out through XRF. This analysis reveals the presence of certain micro, macro and ultra-micro nutrients which can be of great potential as soil amendment and may be beneficial for the proper growth of the plants.

Keywords: Stone industry, Kota stone slurry, XRF Analysis, Micronutrients and Macronutrients

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INTRODUCTION

Stone cutting industry is a classic example of unscientific mixing and improper waste disposal regardless of aesthetic senses and proper land use practices. Kota stone industry is also one of them. It has been reported that about 23 million tonnes of Kota stone waste in powder or slurry forms are being thrown over waste land in Rajasthan every year. Dumping of the waste has many negative implications on the environment. It leads to air, water and land pollution [1]. Nearly 50% of the precious mineral resource is wasted due to non-upgradation of technology in mining, processing and polishing with gang saws [2]. Presently large amounts of stone wastes are generated in natural stone processing plants with an important impact on the environment due to its disposal [3]. The safe disposal of this slurry waste is a big problem as it occupies huge space and is an environmental hazard especially after the slurry dries up. With the continuously increasing depth of overburden and rate of excavation, the cost of waste handling per square feet of Kota stone is found to increase substantially. In many locations around the world stress and strain upon the environment are occurring increasingly and casting shadows of doubts upon the sustainability of the agricultural crops. The greatest waste concern in the stone industry is stone itself, specifically in the forms of overburden, screening residual, waste water sludge and stone fragments. There are two types of natural stone processing wastes; solid and semi liquid or slurry [4]. At present, Kota stone slurry waste generated is being dumped in open space. Improper waste disposal has caused land degradation, ponding and flooding of water, visual impact, loss of aesthetics, pollution, health and safety hazards. There is a need of conversion of these wastes

generated on a large scale by various industries into useful products through judicious handling and technological processing [5].

ENVIRONMENTAL HAZARDS

Stone slurry is a semi-liquid substance consisting of particles originated from the sawing and polishing processes and water used to cool and lubricate the sawing and polishing machines [6]. The main problems caused by this waste are -

1.When dried, the fine particles (size less than 363 micron) become air borne and causes severe pollution [2].
2.Apart from occupational health problems, it also affects machinery and instruments installed in industrial areas. Slurry dumped areas cannot support any vegetation and remain degraded.
3.When dumped on land, it adversely affects the productivity of land due to decreased porosity, water absorption, water percolation etc. [2].
4.Excavation and disposal of such large quantity of waste in Kota stone industry cost about 25% - 35% of the total cost of production [7].
5.Besides, the disposal of such large quantity of solid waste causes serious environmental problems of degradation of land, loss of green pasture and loss of regional aesthetic values.
6.The heap of slurry remain scattered all round the industrial estate is an eye sore and spoil aesthetics of the entire region. Subsequently tourism and industrial potential of the state is adversely affected.
7.Waste from quarry and fabrication operations can be unsafe and environmentally detrimental [7].
8.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 [8].

On studying the above problems, it becomes extremely important to utilize this kind of waste in other industrial activities or to convert them into value added products. The proper waste management is an essential need of stone industries to tackle the problems arise by the waste generated in stone industries. The high cost of water and the environmental problems associated with slurry disposal has motivated the studies and researches to reduce economic losses as well as environmental impact [9]. This mineral waste can be used as soil nutrient after its reclamation into suitable form, as its chemical analysis shows the presence of various macro, micro and ultra-micronutrients.

MATERIALS AND METHODS

The raw material used in the present study has been taken from different units of Ramganj mandi, Kota. Kota stone is an exceedingly fine grained uniformly crystalline calcareous rock of sedimentary nature composed of lime stone and dolomite in a homogeneous mosaic of minerals (in the size range of 15-10 microns). It possesses oil resistant properties. In spite of introducing the most appropriate mining technology larger quantity of waste is generated mainly in the form of powder and some quantity of waste generated while cutting and sizing Kota stone slabs / tiles at quarry floor. The analysis of major and trace elements in this waste is carried out by X-Ray Fluorescence spectroscopic technique (XRF) at Advanced Instrumentation Research Facility (AIRF), Jawaharlal Nehru University, New Delhi. In XRF, primary X-ray beam illuminates the sample, which gets excited. The excited sample in turn emits X-rays along a spectrum of wavelengths characteristic of the types of atoms present in the sample. The atoms in the sample absorb X-ray energy by ionizing, ejecting electrons from the lower (usually K and L) energy levels. The ejected electrons are replaced by electrons from an outer, higher energy orbital. When this happens, energy is released due to the decreased binding energy of the inner electron orbital compared with an outer one. This energy release is in the form of emission of characteristic X-rays indicating the type of atom present [8]. The intensity of the energy measured by the different detectors is proportional to the abundance of the element in the sample.

RESULTS AND DISCUSSION

Waste is a valuable raw material which can be converted into useful products by the application of appropriate processing technologies [10]. Unused powder or slurry comes out as waste while cutting, processing and polishing the Kota stone rocks. XRF analysis of this waste reveals the presence of certain macronutrients and micronutrients which can be utilized as soil amendments to improve the growth of the plants.

Table 1: CHEMICAL ANALYSIS OF KOTA STONE WASTE

COMPONENT	% of WEIGHT
SiO_2	29.27
CaO	36.40
MgO	1.70
Fe_2O_3	0.89
Al_2O_3	0.80
K_2O	0.70

Table: 2 MACRONUTRIENTS IN KOTA STONE WASTE

ELEMENT	% OF WEIGHT
Ca	23.6
Mg	0.693
K	.677

Table: 3 MICRO AND ULTRA- MICRONUTRIENTS IN KOTA STONE WASTE

ELEMENT	WEIGHT(ppm)
Ti	705.73
V	15.69
Mn	543.44
Cu	25.28
Rb	33.86
Sr	142.51
Zr	47.86
Zn	15.84

The Kota stone slurry is found to contain Calcium, Potassium and Magnesium as macronutrients(Table:2) and iron, copper manganese zinc etc. as micronutrients. Some ultra- micronutrients are also found in the waste (Table:3) Calcium is an essential plant nutrient. It breaks the seed dormancy by rupturing the walls of seed and enhances seed germination. The divalent cation (Ca^{2+}) is required for structural roles in the cell wall and membranes, as a counter-cation for inorganic and organic anions in the vacuole and as an intracellular messenger in the cytosol. Potassium is also essential for the performance of multiple plant enzyme functions and it regulates the metabolite pattern of higher plants, ultimately changing the metabolite concentrations. It increases crop resistance to certain diseases by encouraging strong root and stem system [11]. Magnesium is also vital for plant growth and its functions include phosphate metabolism, plant respiration and activation of enzyme systems. It performs many functions in the plant. However, it serves as a component of chlorophyll, the pigment responsible for photosynthesis and for the plant's green colour. Iron is taken by plants as micronutrient and it has a significant role in plant respiration, photosynthesis and energy transfer [12]. Titanium may play a role in photosynthesis and nitrogen fixation, increases chlorophyll content and increases yield [13]. Vanadium compliments and enhances the conversion of inorganic Phosphorus to organic forms in the plants. Plants need copper as micronutrient to complete their lifecycle –to produce viable seeds. Manganese plays a direct role in photosynthesis by aiding chlorophyll synthesis. Zinc controls the production of important growth regulators which affect new growth and development. Several elements such as rubidium and strontium have been found to stimulate the growth of certain plants [14]. This study shows that the nutrients present in Kota stone waste can be utilized after suitable chemical transformation of the waste to enhance the fertility of the soil and growth of the plants.

CONCLUSION

The presence of macronutrients, micronutrients and ultra-micronutrients in the Kota stone waste makes it a valuable product. Manufacturing of value added products from the Kota stone waste will boost up the economic health of the Kota stone industry and will bring it to the international level of competition. This study not only proves a milestone in sustainable and holistic development but would also kindle a lamp of hope against the lengthy shadows of the woeful darkness surrounding this hunger stricken world. From the above discussion it can be derived that Kota stone waste can be used as a soil nutrient enhancer.

Acknowledgement
I am grateful to JNU Delhi for helping me in the chemical analysis of Kota stone waste.

REFERENCES

[1] Gupta RC, In: National Seminar on Multi Story Building of Growing Towns – Problem and Remedies, Dept. of Structural Engg., JNV University, **1999**, Jodhpur, Rajasthan, 351-353
[2] Farhana S, Bhumika P,Jayesh P,.Pitroda J, *Int.J. Eng. Trends Technol*.**2013**,Volume 4 ,Issue 8,142
[3] Misra A, Gupta R, In: Workshop on Gainful Utilization of Marble Slurry and Other Stone Waste; Centre for Development of Stones,**2008**, Jaipur, Rajasthan, 85-92
[4] Almeida N, Branco F Santos J, *Build. Environ. J*.**,2007**,42, 810-819
[5] Jain S, Mathur R, In; National Conference On Current Research In Emerging Trends Of Management, Arts, Science And Technology, 1-2Nov. **2014,** Sunrise University, Alwar, Rajasthan, 12
[6] Shirazi E,In: International Conference On Environmental Science And Development, Department Of Environmental Engineering, Islamic Azad University, **2011**,Tehran, Iran
[7] Pappu A, Saxena M, Arolekar S, *Build. Environ. J*.,**2007,** 42(6), 2311-2320.
[8] Sudan P, Mathur R, Jain S *Int. J.Pharm Bio Sci*.**2015**,6(2),81-84
[9] Agarwal SC, In: Workshop on Gainful Utilization of Marble Slurry and Other Stone Waste; Centre for Development of Stones,**2008**, Jaipur, Rajasthan
[10] Jain S, Mathur R, In: National Conference On Emerging Areas In Chemical Education And Research And National Convention Of Chemistry Teachers,16-18 Oct. **2014** IIS University, Jaipur, Rajasthan,129
[11] Brady C Nyle, The Nature And Properties Of Soils (10^{th} Edn Macmillan Publishing Co. ,New York**1990**)369
[12] Marschner H**,** Mineral nutrition of higher plants, (2^{nd} Edn. Academic Press London, New York**1995)**
[13] Benton Jones J, Tomato Plant Culture In: The Field, Greenhouse And Home Garden (CRC Press, London, New York **2007**)
[14] Sharma BK, Environmental Chemistry, (11^{th} Edn Krishna Prakashan, Meerut, U.P,**2007**)