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COMPARATIVE CHARACTERIZATION OF BLAST FURNACE SLAGS: FROM RAW TO ACTIVATED FOR INNOVATIVE APPLICATIONS

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INTRODUCTION & AIM

El-Hadjar steel company, located in the East of Algeria, produces large quantities of waste and by-products, namely crushed slag and granulated slag.

Blast furnace slag (BFS) is a byproduct of the production of cast iron in a steel blast furnace. It is mainly composed of lime (CaO), silicon (SiO_2), alumina (Al_2O_3), magnesium oxide (MgO), and a low level of metal oxides [1]. Its quantity varies depending on the amount of cast iron produced, which is a very heavy burden for production plants,Herein, the TBFS was converted into a new material mainly composed of silica [1]. The conversion was performed after applying various treatment processes, including chemical, thermal, and mechanical treatments. The decision to synthesize slag was based on the fact that low-quantity siliceous materials have significant specific surface area, good adsorption capacity, and can be reused multiple times in the same process.

METHOD

Treatment of the solid

The slag samples were collected at the blast furnace and raw materials workshop of the hot zone, El-Hadjar steel complex, Annaba, Algeria. The solid samples were in the form of rocks that were dark gray with white spots.

The treatment process was performed in several stages, comprising preliminary washing with distilled water, drying in the open air, grinding into a fine powder, sieving to separate the particles according to their size, additional washing with distilled water, steaming at 105 °C, and finally packaging in plastic boxes

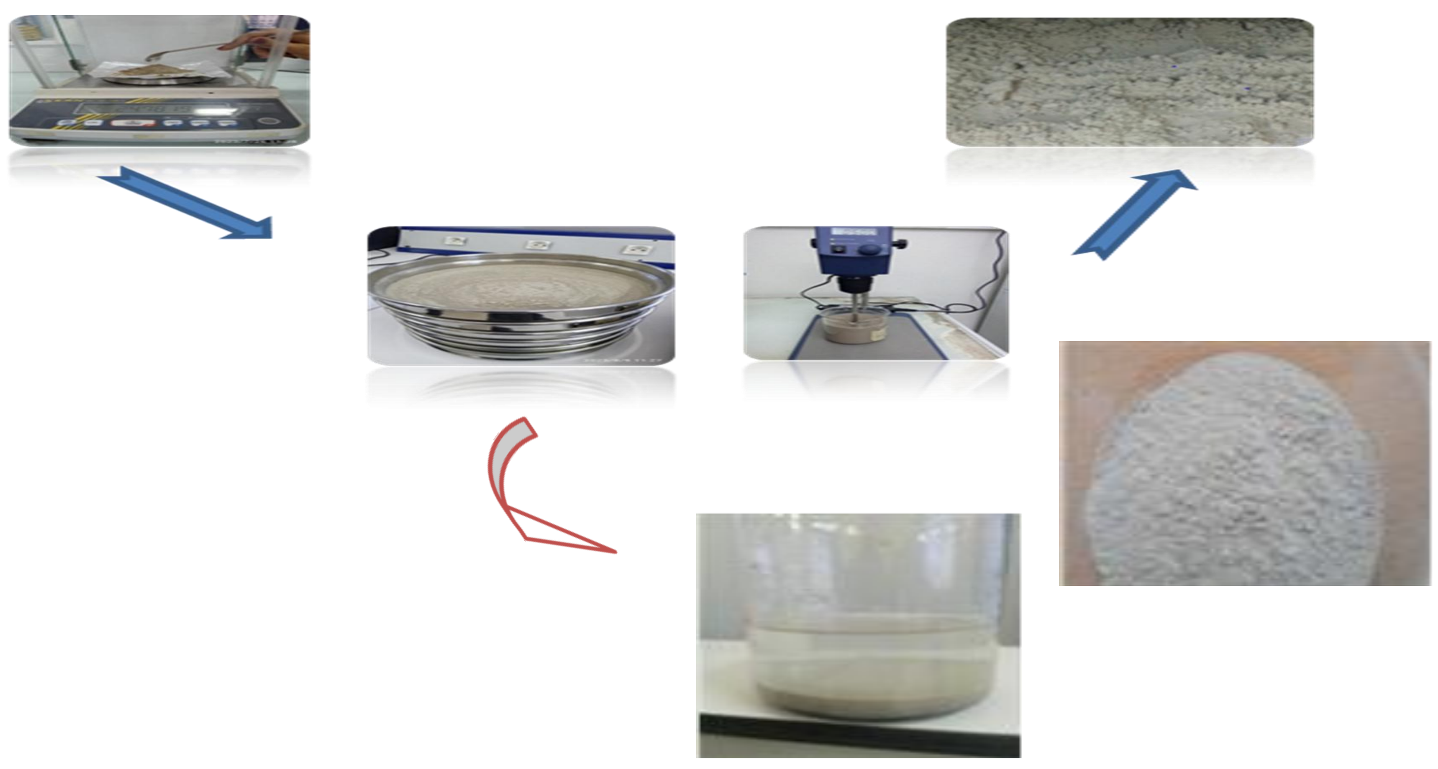

Figure1: Diagram showing the preparation of the new material based on blast furnace slag

RESULTS & DISCUSSION

Characterization of slag

The TBFS was made up of 35.21% CaO, 40.85% SiO2, 11.38% Al_2O_3, 5.03% MgO, and a small proportion of metal oxides (1.04% manganese(II) oxide (MnO), 0.2% potassium oxide (K_2O), and 0.99% sodium oxide (Na_2O); Table1). Figure 2a shows that the XRD analysis results were consistent with those provided by the XRF analysis, revealing significant peaks of CaO and SiO_2, as well as, to a lesser extent, Al_2O_3 and MgO. The EDS analyses, presented in Figure 2c, showed high concentrations of SiO_2, calcium, oxygen, and to a lesser extent aluminum and magnesium, confirming that the TBFS was mainly composed of CaO, SiO_2, Al_2O_3, and MgO in various proportions.

RESULTS & DISCUSSION

Table 1. Chemical composition of the TBFS and SBM

	CaO	Al_2O_3	SiO_2	Fe_2O_3	MgO	MnO	K_2O	Na_2O	SO_3	LOI
	Mass %									
TBFS	35.45	12.96	40.1	2.11	5.12	1.04	0.2	0.7	0	3.94
SBM	6.56	2.11	81.79	0.42	0.86	0.26	0.23	0.44	0.08	7.25

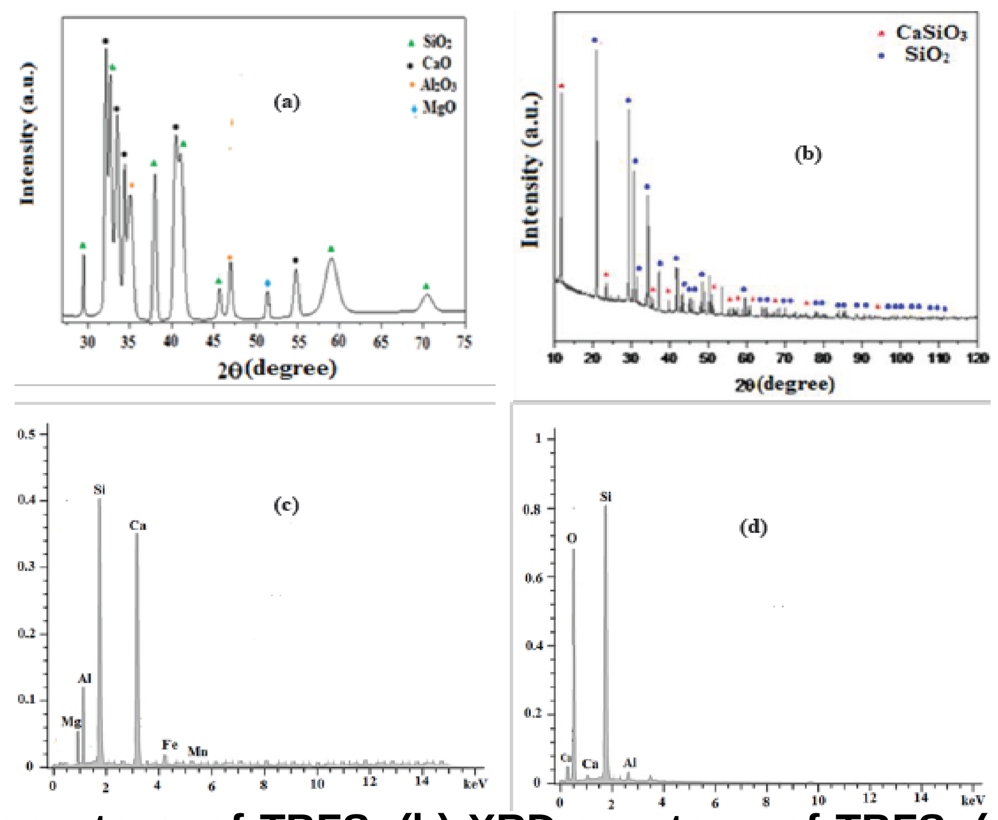

Figure 2. (a) XRD spectrum of TBFS, (b) XRD spectrum of TBFS, (c) EDX spectrum of SBM, and (d) EDX spectrum of SBM.

Adsorption process

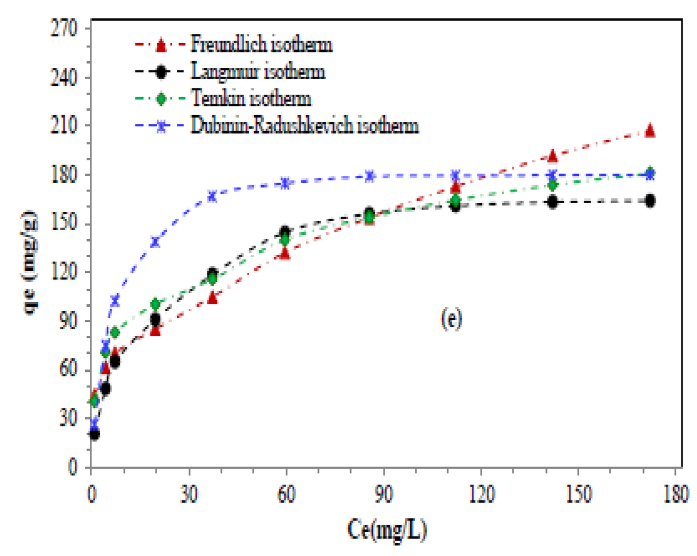

Figure 4. curves of theadsorption isotherms for the lead adsorption on SBM.

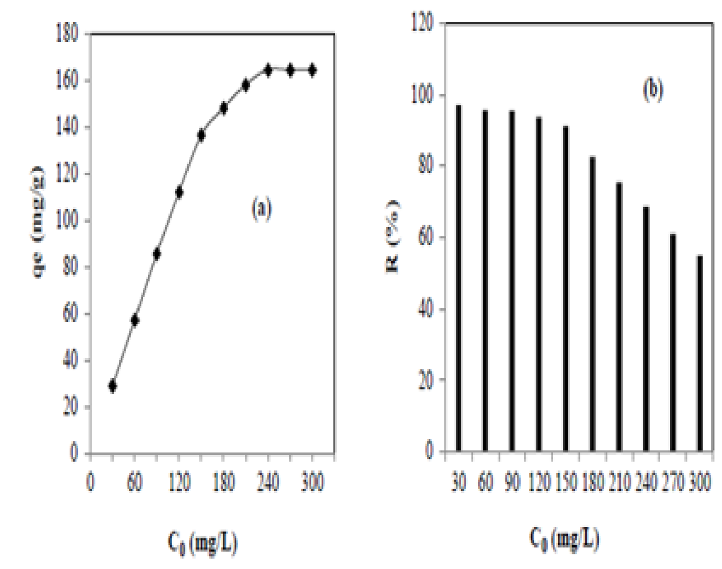

Figure3.(a) Effect of the initial concentration and (b) lead removal performance by SBM.

CONCLUSION

Our study delves into understanding the microstructural and compositional changes induced by various activation methods and their direct impact on the adsorption capacity of the slags. To comprehensively evaluate and quantify these transformations, we employ advanced characterization techniques such as X-ray Diffraction (XRD), and specific adsorption tests. The primary objective is to demonstrate how activation transforms a material often considered waste into an efficient and cost-effective adsorbent. This valorization of BFS not only contributes to the circular economy but also offers sustainable solutions for pollution control and environmental remediation. Future prospects for this research include further optimizing activation processes and exploring novel high-value applications for BFS, such as the removal of emerging pollutants or the recovery of valuable resources,

FUTURE WORK / REFERENCES

[1]Chouchane T, Khireddine O, Boukari A. Kinetic studies of Ni(II) ions adsorption from aqueous solutions using the blast furnace slag (BF slag). Journal of Engineering and Applied Science 2021; 68: 34.