Study of gypsum wastes as by-products from several quarries examined in the Tabernas desert (Almería, Spain)

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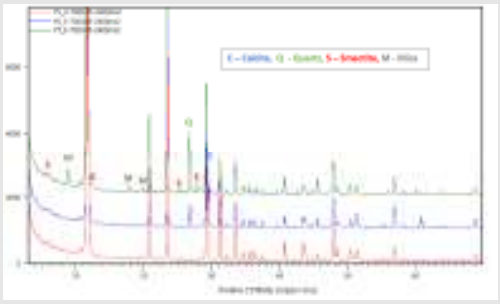
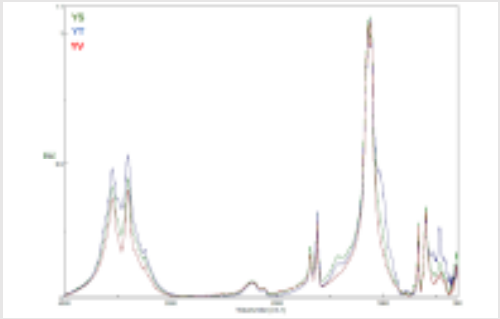
INTRODUCTION AND OBJECTIVE

Several quarries containing gypsum in the Tabernas desert (Almería, Spain) have been examined. The main purpose was to deduce if the samples with lower gypsum content, considered as waste or by-products of gypsum mining, can be applied in construction (Fig. 1).

Figure 1.- General view of Tabernas desert, with high slopes and poor vegetation cover.



(a)



(b)

Figure 2: XRD diagrams (a) and FTIR spectra (b) of three selected gypsum samples (YS, YT, YV). All the diffractions identified in the XRD diagrams are associated to gypsum CaSO4 2H2O) with impurities such as calcite (C), quartz (Q), smectite (S) and mica (M).

EXPERIMENTAL

The main techniques used in this study to determine the mineralogy, chemical characteristics and morphologies of these samples have been X-ray Diffraction and Fluorescence (**XRD** and **XRF**), Fourier Transform Infra-Red Spectroscopy (**FT-IR**), physisorption of nitrogen and electron microscopy (**SEM**) with chemical analysis by Energy Dispersive X-ray Spectroscopy (**EDS**) (Fig.3).

Thermal behaviour has been investigated using thermal analysis (DSC-TGA) and conventional furnace heating up to 1000 ºC.

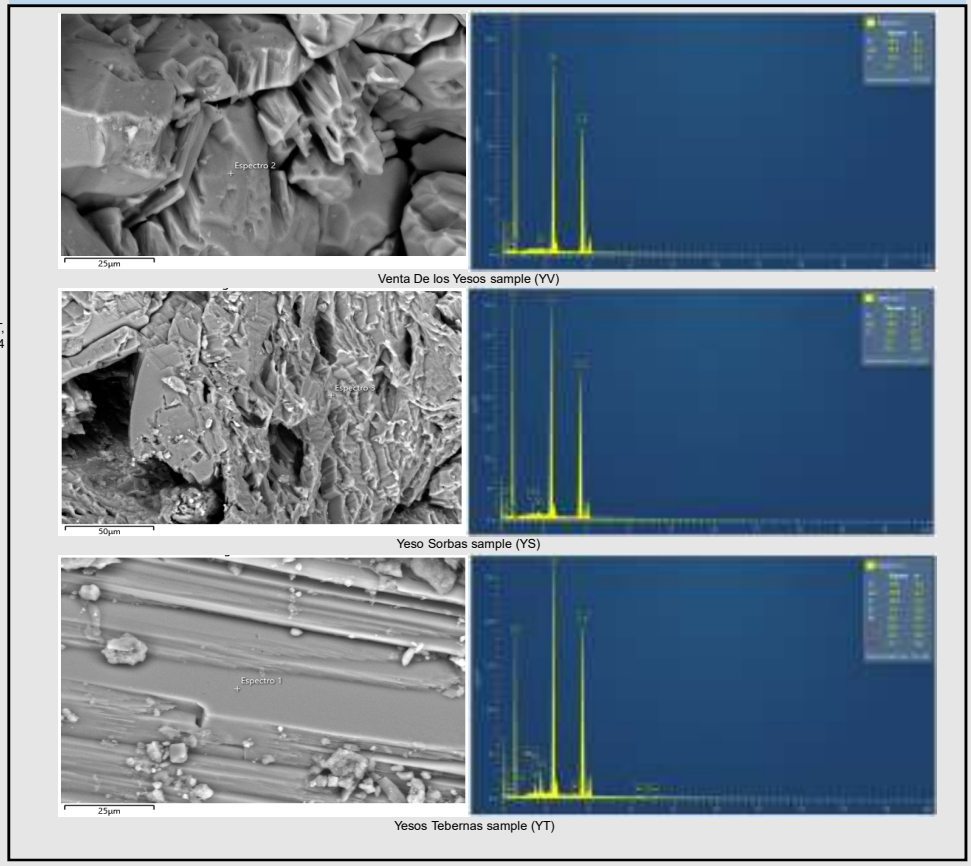


Figure 3: SEM micrographs and EDX spectra of three selected samples (YV, YS and YT)

RESULTS AND DISCUSSION

The mineralogical analysis by **XRD** of three selected samples indicated that gypsum is the main crystalline phase, showing a relatively low proportion of calcite and quartz, with smectite and muscovite in some samples. FT-IR analysis confirmed these results (Fig. 2).

Chemical analysis supported the mineralogical results, allowing the determination of trace elements by XRF. It is well-known that Calcium Sulphate dihydrate ($CaSO_4 \cdot 2H_2O$), gypsum, and anhydrite ($CaSO_4$) are often associated together in nature. Gypsum is the most important commercially. Only gypsum was present according to the XRD and XRF results.

Heating of these samples showed small exothermic DSC effects (maxima in the range 343-357 ºC), being attributed to the transformation of soluble anhydrite into insoluble anhydrite. Gypsum converts to anhydrite *via* an intermediate mineral, the hemihydrate or bassanite ($CaSO_4 \cdot 0.5H_2O$).

It was found important variations in the textural parameters obtained by physisorption when the samples were thermally treated, being associated to the different mineralogy with gypsum contents in the range 69-93 wt. %. This feature will influence the possible applications of these gypsum samples.