STUDY AND COMPARATIVE MODELING ON THE PERFORMANCE OF HALLOYSYTIC KAOLIN OF THE REGION OF MAR DE ESPANHA (MG - SOUTHEAST OF BRAZIL), IN ADSORB AND RELEASE ION K^+.

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INTRODUCTION

Halloysitic kaolin is fine granulometry composed of kaolinite and halloysite and secondarily by muscovite, quartz and feldspar. The deposits derived from the *in situ* alteration of feldspar rich rocks are denominated primary and of secondary sedimentary origin. The deposits that are in the southeast of Minas Gerais (Eastern Pegmatitic Province, in the Paraíba do Sul, Raposo and Andrelândia groups). Halloysite exhibits hexagonal tubular morphology and has distinct kaolinite technological properties. It is used in special segments of the industry, as a transport mechanism and controlled release of active principles.

The objective of the study is to: (i) characterize the performance of halloysitic kaolin as adsorber and also as K^+ releasing agent in the environment; (ii), and compare the performance of halloysitic kaolin with sodium bentonite (most commonly used in agriculture).

EXPERIMENTAL PART

The samples obtained in the region of Mar de Espanha (MG) (Fig.1) were benefited (Fig.3) in the CETEM by granulometry (<44µm) followed by magnetic separation, chemical bleaching and gravitational hydraulic sorter (CHG) (Fig.2). The fractions were analyzed by granulometry, X-ray diffractometry, X-ray fluorescence and scanning electron microscopy (SEM). These analyzes identified the presence of halloysite and euhedral kaolinite, feldspar, muscovite, quartz and impurities.

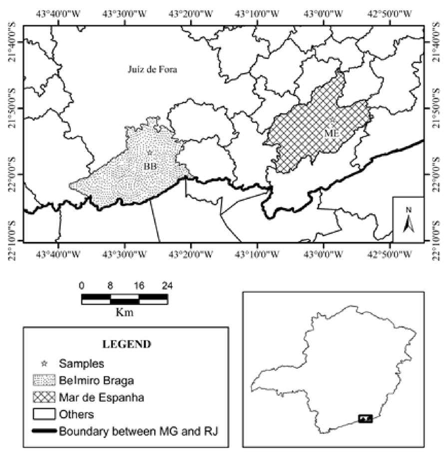


Figure 1: Sampling Location.

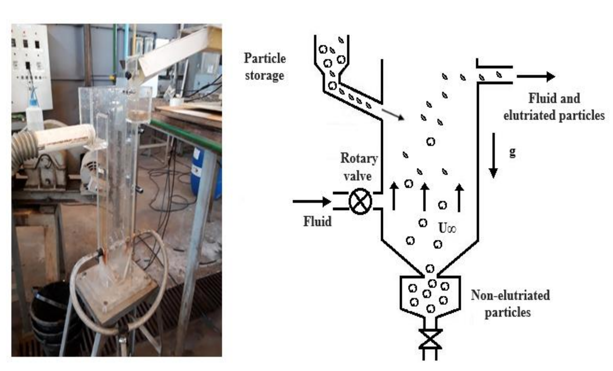


Figure 2: Gravitacional Hydraulic Sorter (CHG)

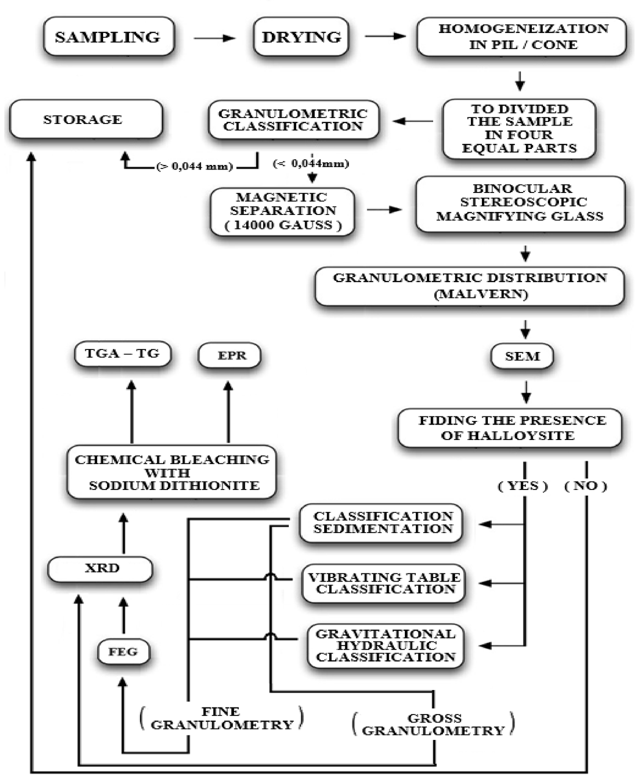


Figura 3: Flowchart of the beneficiation, classification and analysis process .

RESULTS

The ME and BB samples indicate the presence of halloysite, euedric kaolinite, feldspar, muscovite, quartz and impurities. CHG processing was able to separate 54.43 and 23.46 (mass%) respectively. In SEM and FEG microscopy images halloysite crystals appear with their characteristic habit (Fig.4). In the granulometric distribution diagram, the ME sample has a monomodal distribution, while samples C and BB have a bimodal distribution (Fig.5).

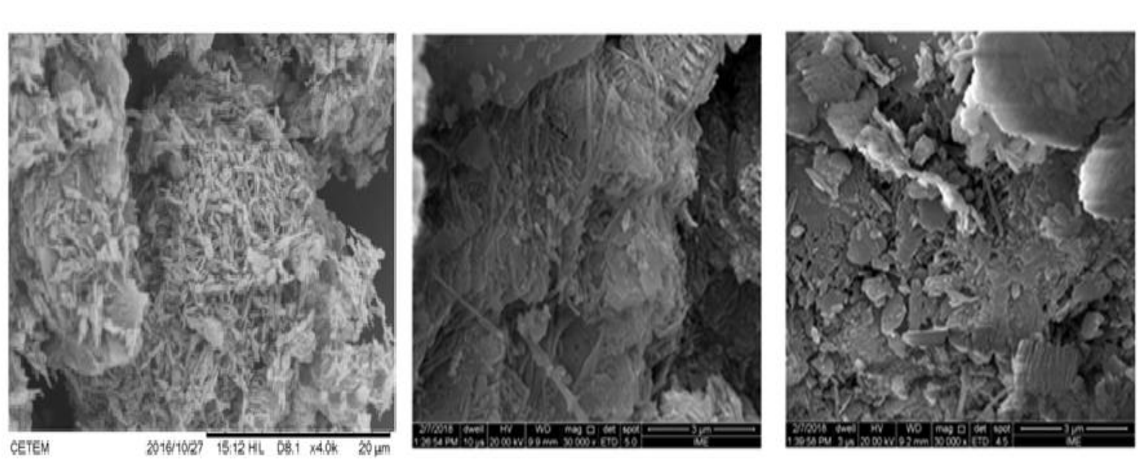


Figure 4: SEM C microscopy image of sample C (6.0k magnification) (left), FEG microscopy (30.0 k magnification) of sample BB (center) and sample ME (right).

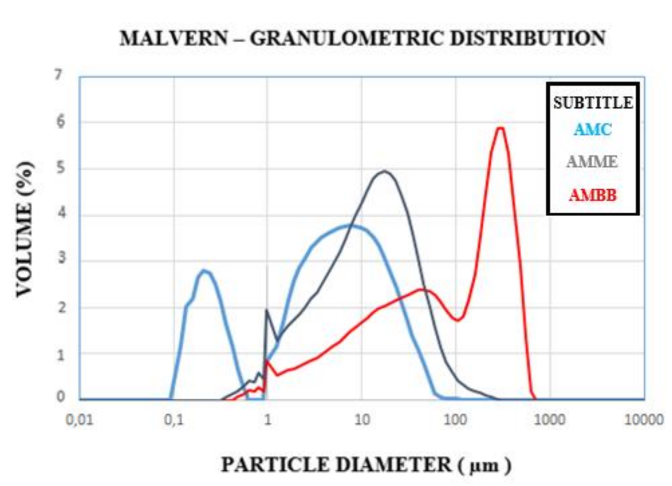
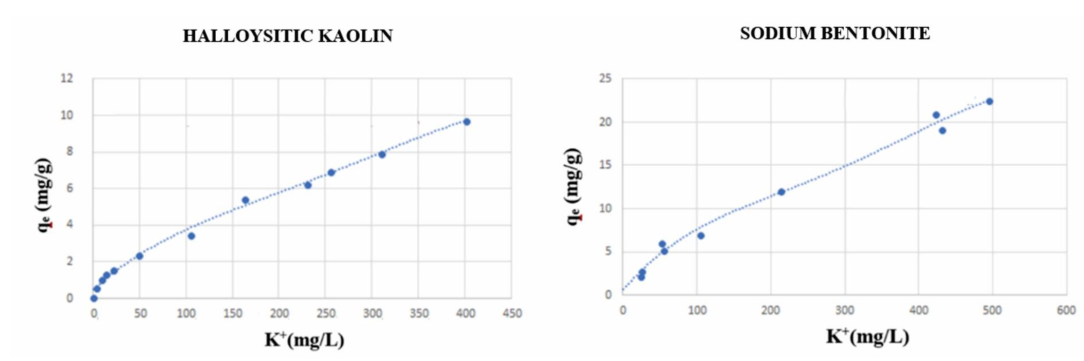


Figure 5: Granulometric Distribution

The performance of halloysitic kaolin as adsorber and K^+ (1) releaser was tested and compared to the performance of sodium bentonite (2). It was expected to find what is commonly referred to as the adsorption isotherm (the ratio of adsorbed amount of adsorbate (mg/g) to equilibrium adsorbate concentration (mg/L) at constant ambient temperature of 25ºC). Polynomial mathematical modeling [adsorption (Fig.6) and release (Fig.8)] for both materials (halloysitic kaolin and sodium bentonite) showed similarity. Noting that while the adsorption isotherm for sodium bentonite was generated at concentrations of 25-1000 mg/L, for halloysitic kaolin the concentration was in the range 25-400mg/L. A logarithmic model was developed (Fig.7) to verify whether the polynomial models were matched. The logarithmic model for K^+ adsorption (Fig.7) presents a difference between halloysitic kaolin (3) and sodium bentonite of 1.36%, and for K^+ release (Fig.9) presents a difference of 0.68%. Thus, it can be said that in relation to sodium bentonite the halloysitic kaolin has an adsorption rate of 50%, and a release rate of 20%.

RESULTS



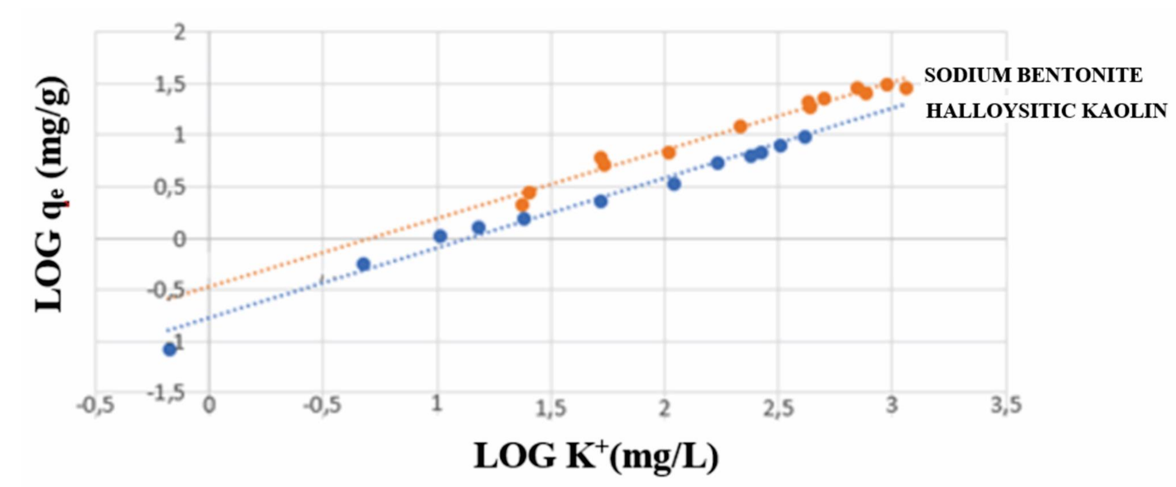
Legend:

$Y = -(5E\text{-}10)x^4 + (5E\text{-}07)x^3 - (2E\text{-}04)x^2 + (4{,}64E\text{-}02)x + 0{,}4607$ (HALLOYSITIC KAOLIN)

$Y = -(8E\text{-}10)x^4 + (1E\text{-}06)x^3 - (4E\text{-}04)x^2 + (1{,}009E\text{-}01)x + 0{,}5627$ (SODIUM BENTONITE)

where: $Y = q_e$ (mg/g) $X = K^+$ (mg/L)

Figure 6: Adsorption - HALLOYSITIC CAULIN and SODIUM BENTONITE Mathematical Model

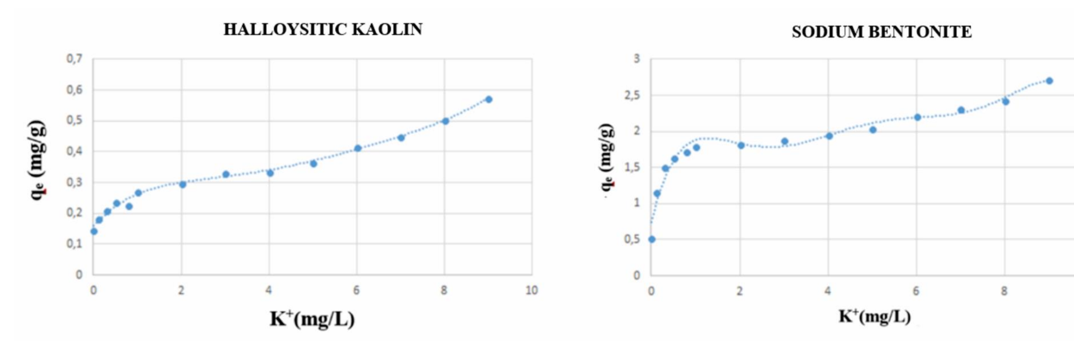


Legend:

■ : $LOG\ Y = 0{,}6774\ LOGX - 0{,}6773$ (HALLOYSITIC KAOLIN)

■ : $LOG\ Y = 0{,}6639\ LOGX - 0{,}4689$ (SODIUM BENTONITE)

Figure 7: Adsorption - Model for Halloysitic Kaolin and Sodium Bentonite

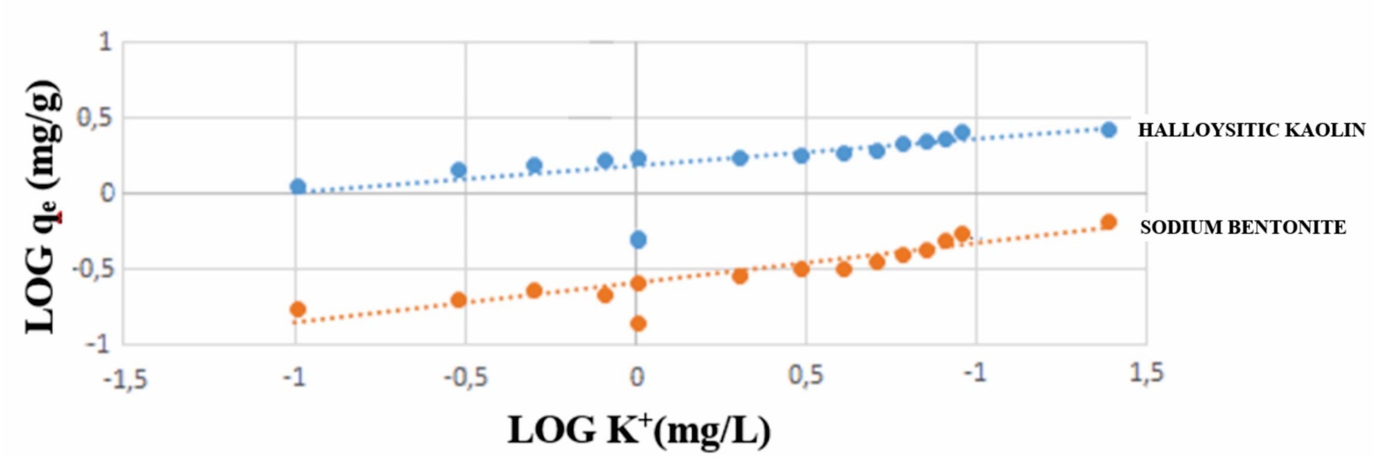


$Y = -(2E\text{-}6)x^6 + (1E\text{-}4)x^5 - (2E\text{-}3)x^4 + (1{,}72E\text{-}2)x^3 + (7{,}15E\text{-}2)x^2 + (0{,}1593)x + 0{,}1595$ (HALLOYSITIC KAOLIN)

$Y = -(4E\text{-}4)x^6 + (1{,}07E\text{-}2)x^5 - (0{,}1258)x^4 + (0{,}7147)x^3 - (1{,}9987)x^2 + (2{,}5277)x + 0{,}749$ (SODIUM BENTONITE)

Where: $Y = q_e$ (mg/g) $X = K^+$ (mg/L)

Figure 8: Release - Model for Halloysitic Kaolin and Sodium Bentonite



Legend:

■ : $LOG\ Y = 0{,}2632\ LOGX - 0{,}5851$ (HALLOYSITIC KAOLIN)

■ : $LOG\ Y = 0{,}179\ LOGX - 0{,}5851$ (SODIUM BENTONITE)

Figure 9: Release - Logarithmic Model for Halloysitic Kaolin and Sodium Bentonite

CONCLUSION

The conclusion is that the relationship of the adsorption/release isotherm mathematically modeled for both materials (kaolin and sodium bentonite) showed similarity. And that in relation to sodium bentonite, halloysitic kaolin has an adsorption rate of 50% and a release rate of 20%. And that the ideal solution concentration should be between 25-400 mg/L. Halloysitic kaolin has been shown to be able to adsorb and release K^+ ion at a lower rate than sodium bentonite, and for a solution with 50% concentration used for sodium bentonite.

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THANKS

V REUNIÃO ANUAL SOBRE ARGILAS APLICADAS