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EFFICIENCY OF MODIFIED CLAYS IN WATER SOFTENING

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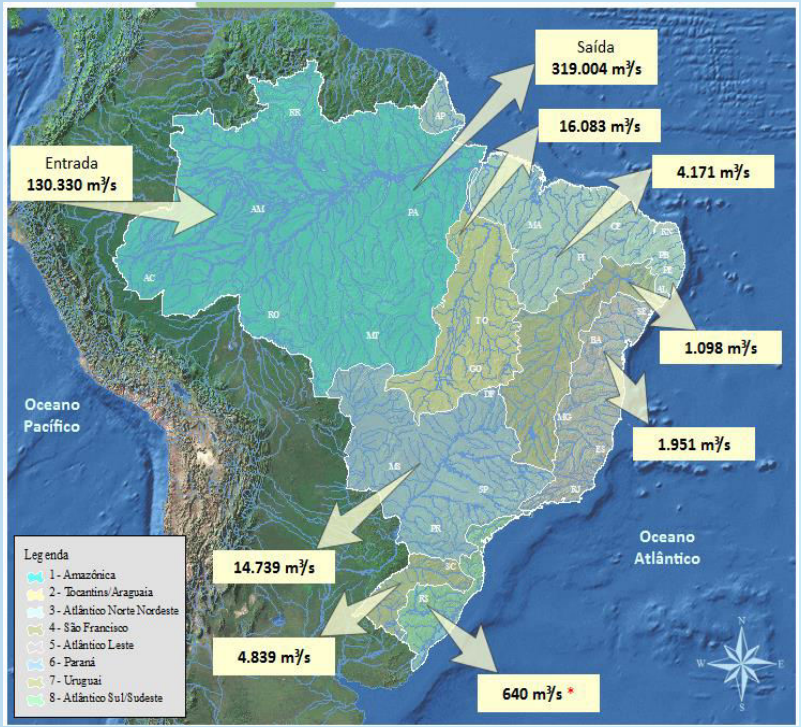
➢ Water resources in Brazil

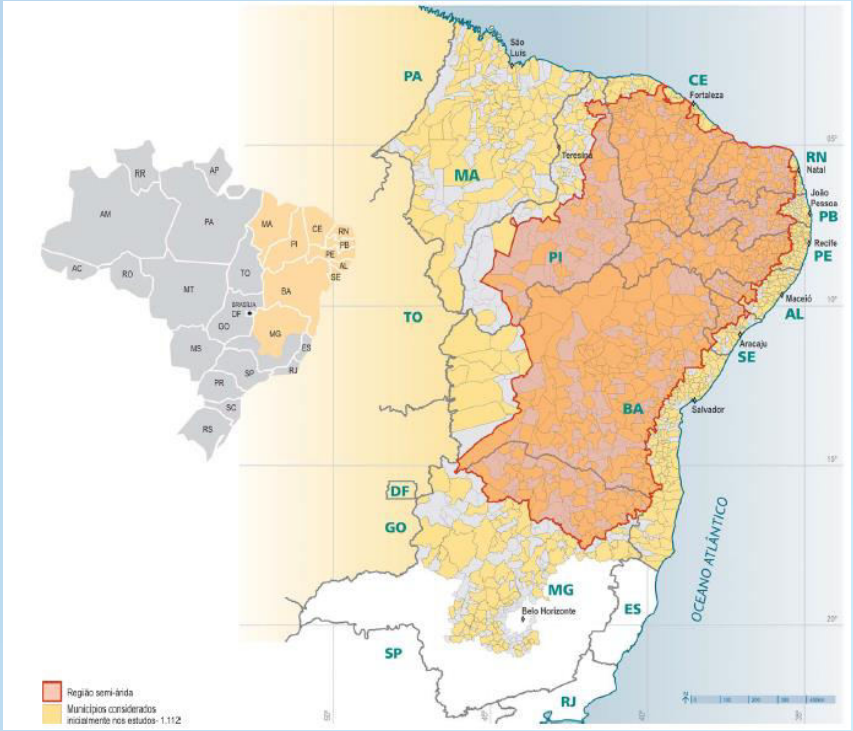
- Vast availability of water;
- Not distributed uniformly.



Source: BRASIL, ANA, 2015

➢ Brazilian northeast

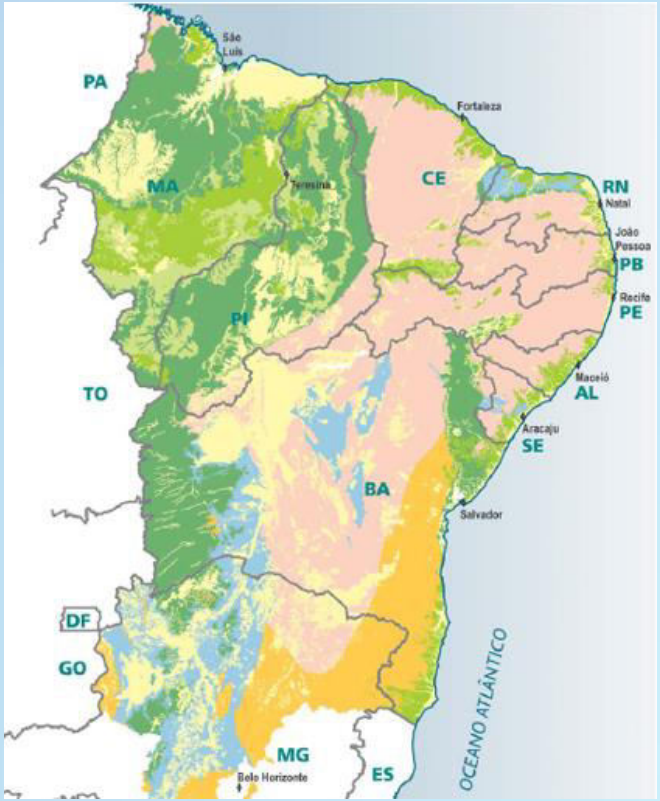
- Total area: 1,000,000 m^2;
- 1,132 municipalities;
- Population: 20,000,000;
- Low water reserves;
- High average annual temperature (35-40^oC);
- Irregular precipitation (regional and frequency).



Source : BRASIL, ANA, 2006

➢ Occurrence of hard water

- Limestone contributes to hard water (blue areas);
- Occurs in different regions in Brazil;
- Same problem exists in other countries.



Source : BRASIL, ANA, 2006

➢ Problems caused by elevated water hardness

- Agriculture: hinders plant growth (osmotic processes) and alters soil properties;
- Human consumption: changes taste of water, does not eliminate thirst, may cause intestinal problems and kidney stones;
- Industrial processes: encrustations raise maintenance costs.

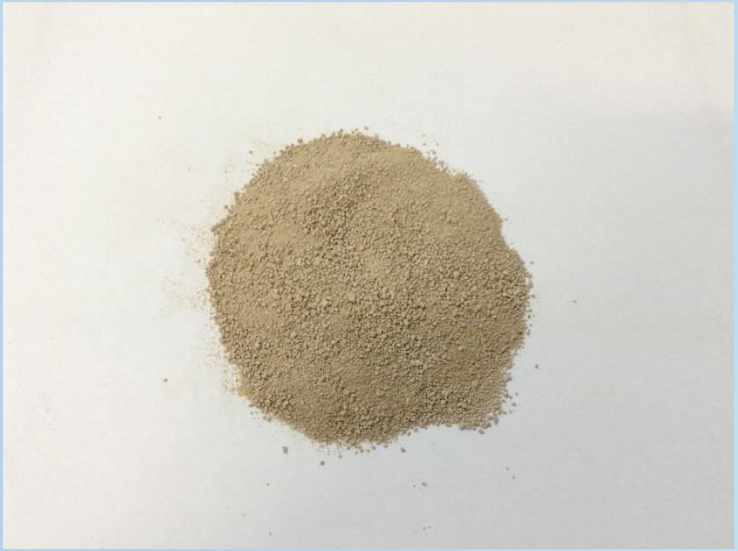
Source:
www.finkler.net.br

- **Clays**

  - Distributed around the world;
  - Low cost;
  - Can be modified using simple methods;
  - Can be reused.

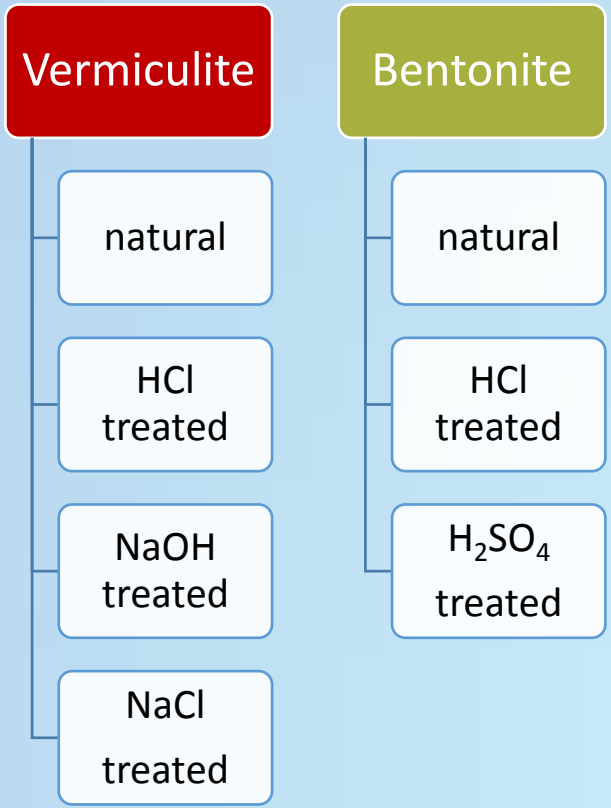
➢ Clays used in this work

Bentonite



Vermiculite

➢ Materials and methods



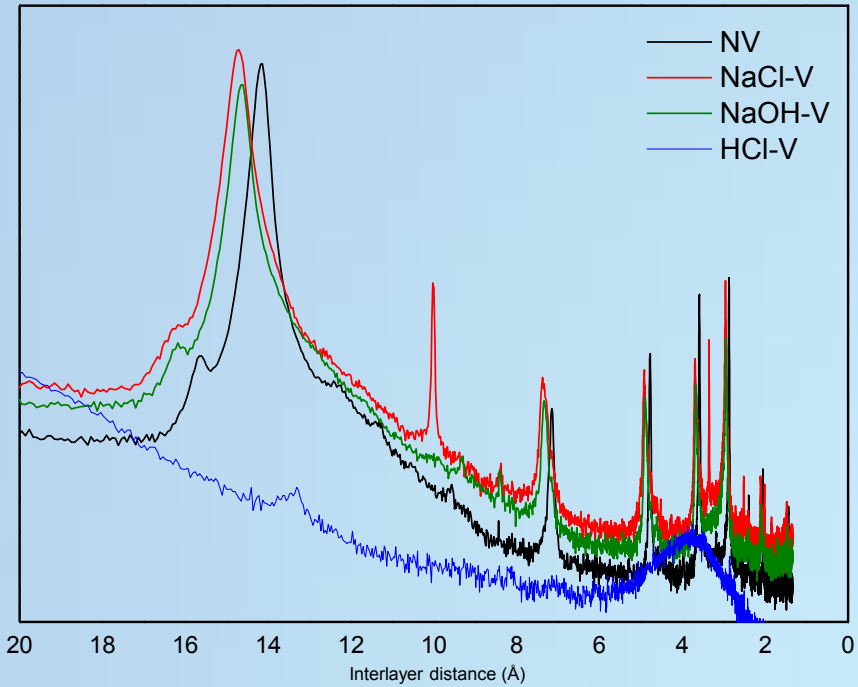
Part 1 – magnetic stirring

- Vermiculites
- Bentonites

Part 2 – Column filtration

- Clays with better results in the above test

➢ Results and discussion



Chemical modifications of the clays were attested with X-ray analyses. Differences in curves attest changes.

Table 1 - Hardness percent reduction after magnetic stirring testing.

Analyzed Sample	Hardness Reduction
Filtrate 1 (after contact with 1g natural bentonite)	9.44%
Filtrate 2 (after contact with 1g hydrochloric acid treated bentonite)	19.30%
Filtrate 3 (after contact with 1g sulfuric acid treated bentonite)	22.78%
Filtrate 4 (after contact with 1g natural vermiculite)	9.15%
Filtrate 5 (after contact with 1g sodium chloride treated vermiculite)	57.53%
Filtrate 6 (after contact with 1g sodium hydroxide treated vermiculite)	46.33%
Filtrate 7 (after contact with 1g hydrochloric acid treated vermiculite)	43.58%

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best results

Table 2 - Hardness percent reduction after column filtration testing.

Analyzed Sample	Hardness Reduction
Filtration 1 (after contact with 1g natural vermiculite)	10.38%
Filtration 2 (after contact with 1g NaCl treated vermiculite)	17.92%
Filtration 3 (after contact with 1g HCl treated vermiculite)	28.40%
Filtration 4 (after contact with 1g NaOH treated vermiculite)	17.92%

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Because of the smaller contact time, we have different results.
However, the softening capacity of the hard water is confirmed.

➢ Conclusions

- Clays can be used in the softening of water;
- Vermiculite has the best efficiency;
- Bentonites also have a potential for that purpose - need more intense treatments;
- Efficiency of the sodium chloride treated vermiculite for water softening generates optimistic expectations - simplicity and low cost - future applications on treatment systems.

➢ Now, some questions

1) Can low cost devices be made for water softening using clays?

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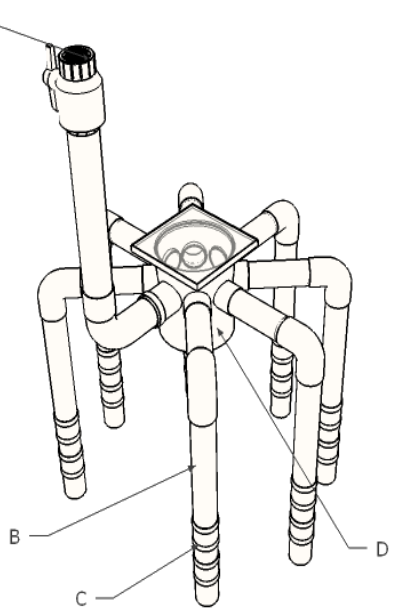
Something like this...

A. water inlet
B. cylindrical columns
C. cartridges with clays
D. tank



- **Now, some questions**

2) Can clays used in the water softening, such as vermiculite treated with sodium chloride, be reconditioned?

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Yes. It is an easy and low cost procedure.

Thus, the clay can be reused.

This is the best news!

- **Thank you for watching my presentation.**

- **More questions and contributions...**

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