Sustainable materials for environment:

A focus on the natural zeolite clinoptilolite

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During the last decades, the greenhouse gas emissions due to anthropogenic activities have led to severe environmental issues. Therefore, to mitigate the CO_2 emissions several technologies have been proposed and applied. Such technologies are focused on usage of sustainable sorbents for CO_2 capturing and viable processes for utilizing CO_2 in a circular economy. The main techniques used for post-combustion CO_2 capture include solid adsorption, solvent scrubbing and membrane separation. However, the solvent scrubbing suffers from high-energy penalty comparing to adsorption processes with solid sorbents. On the other hand, solid adsorption provides favorable advantages including the absence of corrosivity, the low volatility and the low energy penalty. Among the adsorbents used for CO_2 separation processes, zeolites could be promising materials due to their textural and structural properties, polarity, and cation exchange potential. In this contest, the natural zeolite clinoptilolite appears a potential candidate for flue gas treatment due to its promising CO_2 adsorption capacity at moderate temperature [1,2]. Because of its unique chemical and physical properties, clinoptilolite can be effective for several other environmental applications, including water/waste water treatment (e.g. heavy metal and organic pollutants removal) [3], sustainable agriculture (e.g. slow-release fertilization, soil conditioning, remediation, zeoponic plant-growth substrates) VOCs and odor reduction [4]. However, many other environmental, sustainable and energy-related applications can be realized with clinoptilolite. Moreover, the costs for clinoptilolite are relatively low and typically range from $100 to $600 per metric tons, depending on the zeolite content and processing, origin and market prices. As a result, clinoptilolite seems to be a promising candidate for sustainable applications. This lecture will give an overview of the main physico-chemical properties and environmental applications of the clinoptilolite, taking in consideration the last scientific reports and experimental results obtained by our research group.

References

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