Effect of nickel content in NiMo/Al_2O_3 catalyst on yield and reaction pathways during the hydrotreating of high-oleic sunflower oil

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Introduction

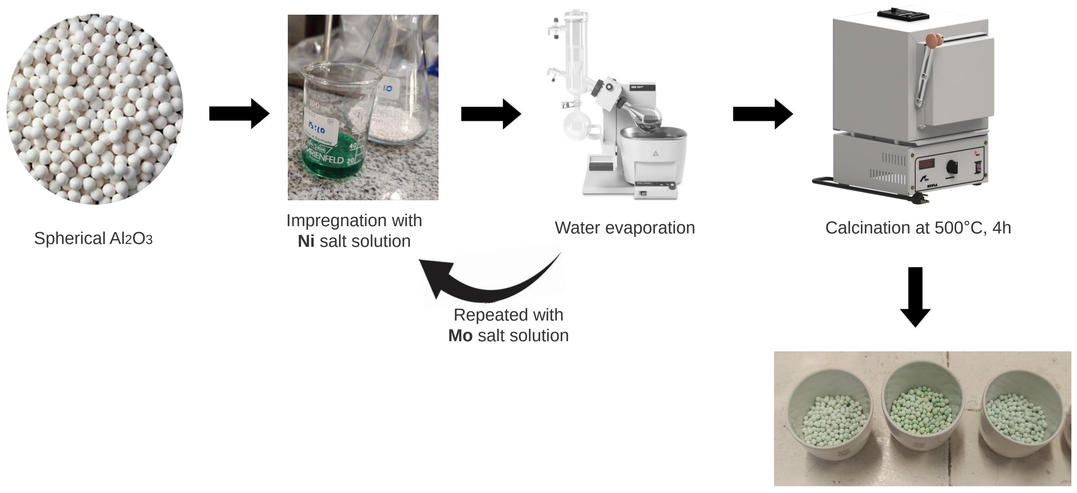
- Catalytic hydrotreating of vegetable oils is a promising and convenient alternative for producing renewable biofuels.
- The process enables the direct conversion of triglycerides (**TAG**) under high-pressure hydrogen conditions into hydrocarbons (**HC**) structurally analogous to those found in liquid fossil fuels.
- A key step in this transformation is oxygen removal, which occurs through three main pathways: hydrodeoxygenation (**HDO**), preserving the chain length of the fatty acid substrate (**FFA**); hydrodecarbonylation (**HDCn**) or hydrodecarboxylation (**HDCx**), reducing the chain length by one carbon atom.

Objective

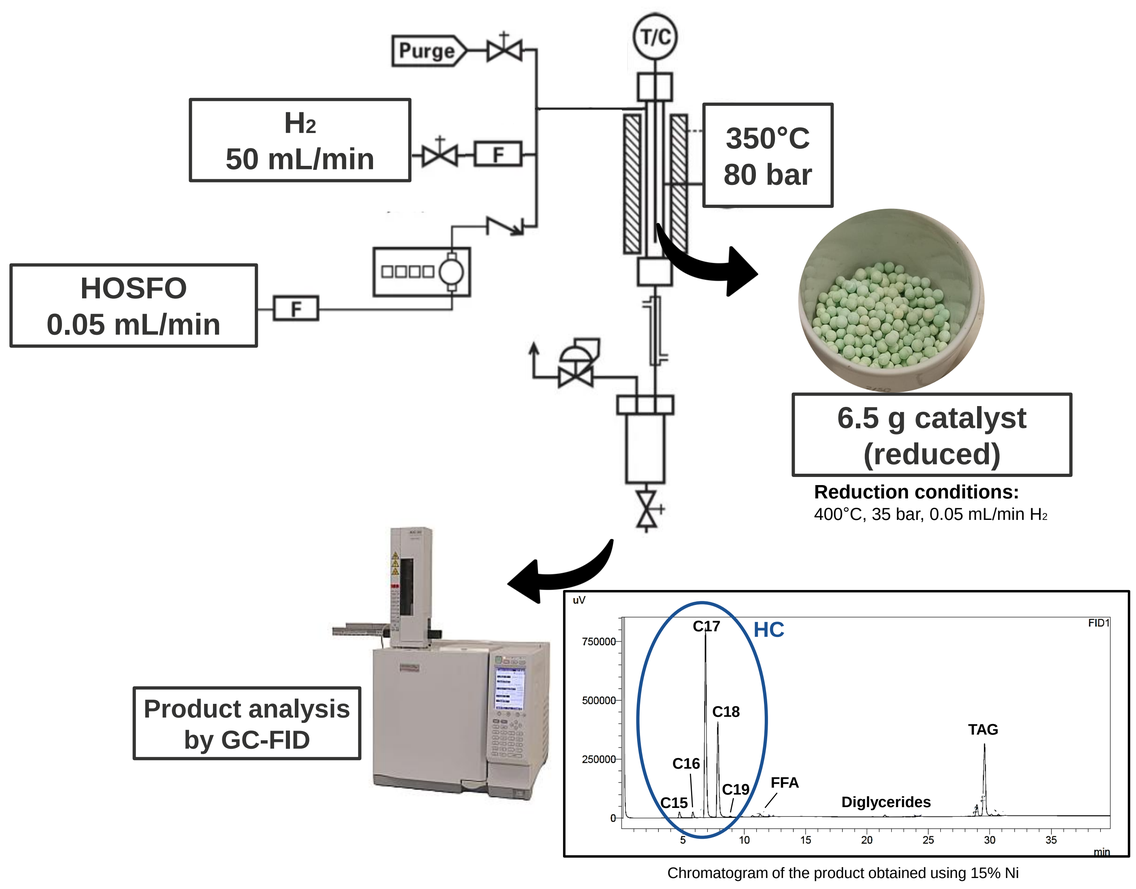
This work analyzes the effect of nickel content in NiMo/Al_2O_3 catalysts on the conversion and selectivity of deoxygenation pathways during the hydrotreating of refined high-oleic sunflower oil (**HOSFO**).

Methodology

Cataylsts preparation



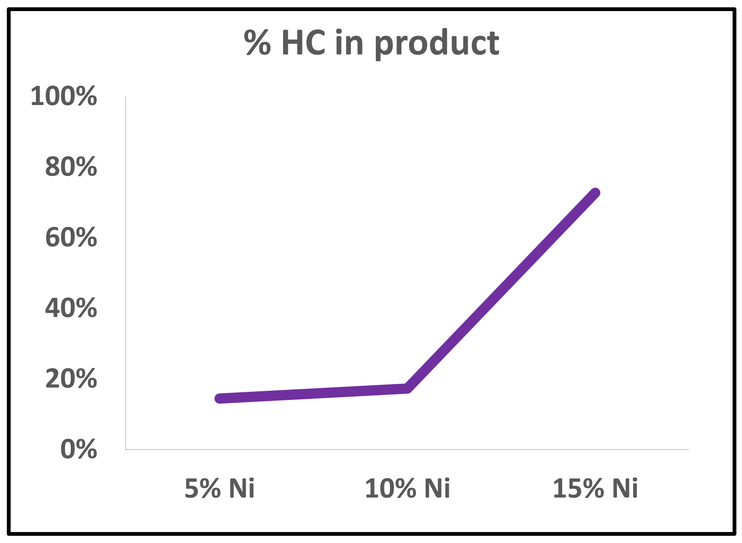
Hydrotreating reaction



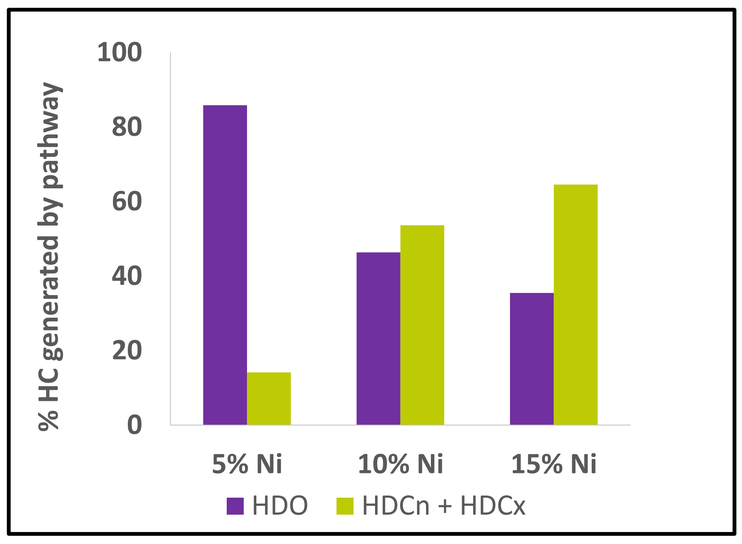
Chromatogram of the product obtained using 15% Ni

Results

The percentage of HC in the product increased from 14 to 73 % when the load of Ni in the catalyst rose from 5 to 15%.



The Ni increase was accompanied by a marked shift in pathway selectivity, with a decrease in HDO contribution.



Textural analysis showed no substantial differences among catalysts, suggesting that higher conversion and change in reaction pathway are attributed to the effect of Ni active sites.

Ni content (%)	BET surface area (m^2/g)	Pore volume (cm^3/g)	Micropore volume (cm^3/g)
5	230,0	0,42	0,0087
10	211,6	0,40	0,0071
15	211,5	0,36	0,0092

Conclusions

- A high nickel content not only enhances the activity of NiMo/Al_2O_3 catalysts in the hydrotreating of high oleic sunflower oil, but also modifies the nature of active sites, promoting oxygen removal via hydrodecarbonylation and hydrodecarboxylation.
- Considering that both routes allow conversion to occur with lower hydrogen consumption than hydrodeoxygenation, but also with a lower atom economy, the Ni load in the catalyst is determinant in the balance between hydrogen consumption and final fuel yield.

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