# Study on the reuse of the catalyst $NbOPO_4.nH_2O$ in the conversion of sugarcane biomass into furfural

Kisla S. Furtado[a], Diego M. Chaves[a], Alexandra J. Esposito[a], Ricardo Natalino[a], Luiz A. Peternelli[b], Márcio H. P. Barbosa[c], Reinaldo F. Teófilo[a*].

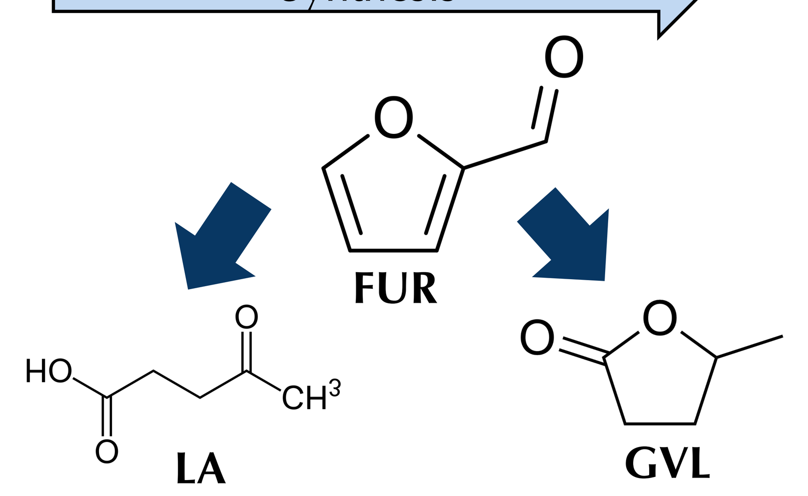
[a] Department of Chemistry; [b] Department of Statistic and [b] Department of Agronomy, Universidade Federal de Viçosa, 36570-900, Viçosa, MG, Brazil

* *rteofilo@ufv.br*

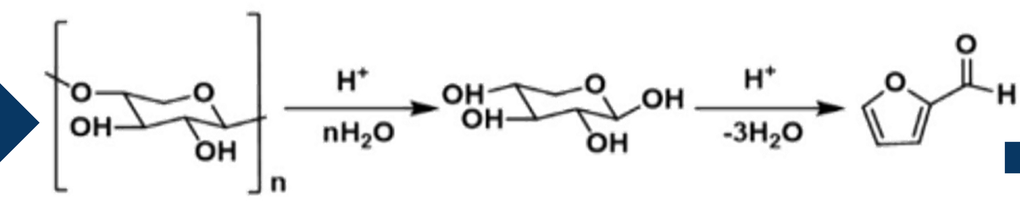
## INTRODUCTION

Furfural (FUR) was identified as a valuable chemical platform with potential to be a sustainable alternative to petrochemical.

Synthesis

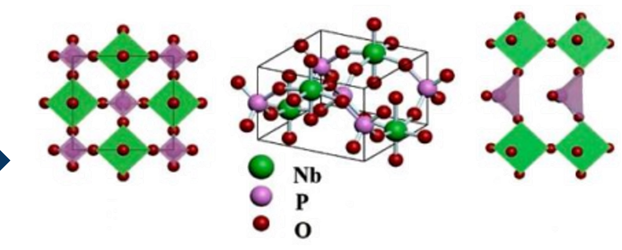



FUR is industrially produced from lignocellulosic materials (corncobs, sugarcane bagasse, oats, almond husks, and others. employing mineral acids (*i.e.*, $H_2SO_4$ or HCl) as catalyst.




Disadvantages of mineral acids

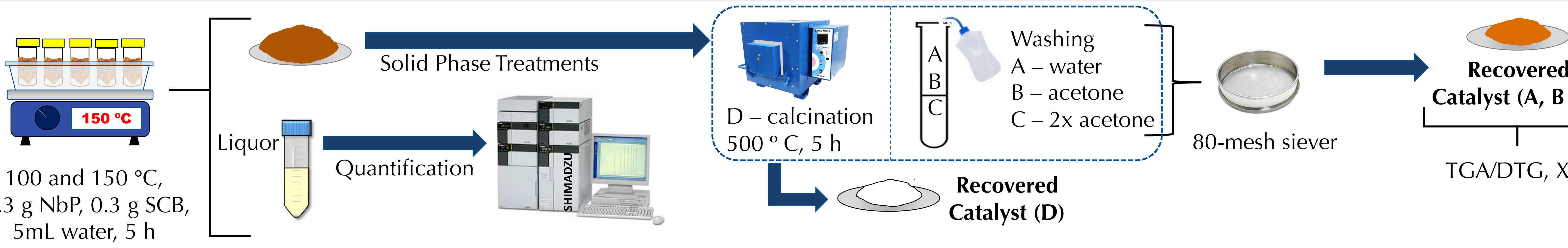
- Corrosion of the equipment
- Difficulty in separation
- Impossibility of reuse




Use of solid catalysts as niobium phosphate $NbOPO_4$.

The aim of this work is to study NbP reusability for furfural production directly from sugarcane bagasse in the auto hydrolysis reaction.

## MATERIALS AND METHODS




100 and 150 °C, 0.3 g NbP, 0.3 g SCB, 5mL water, 5 h

Solid Phase Treatments

Liquor — Quantification

D – calcination 500 º C, 5 h

Washing
A – water
B – acetone
C – 2x acetone

80-mesh siever

Recovered Catalyst (A, B , C)

TGA/DTG, XEDS

Recovered Catalyst (D)

HPLC Method: Bio-Rad Aminex HPX-87H, 65 º C, Acetic Acid 0.085 % and Acetonitrile 85:15, 0.8 mL min-[1], ELSD 350 Mpa and PDA 305 nm

## RESULTS

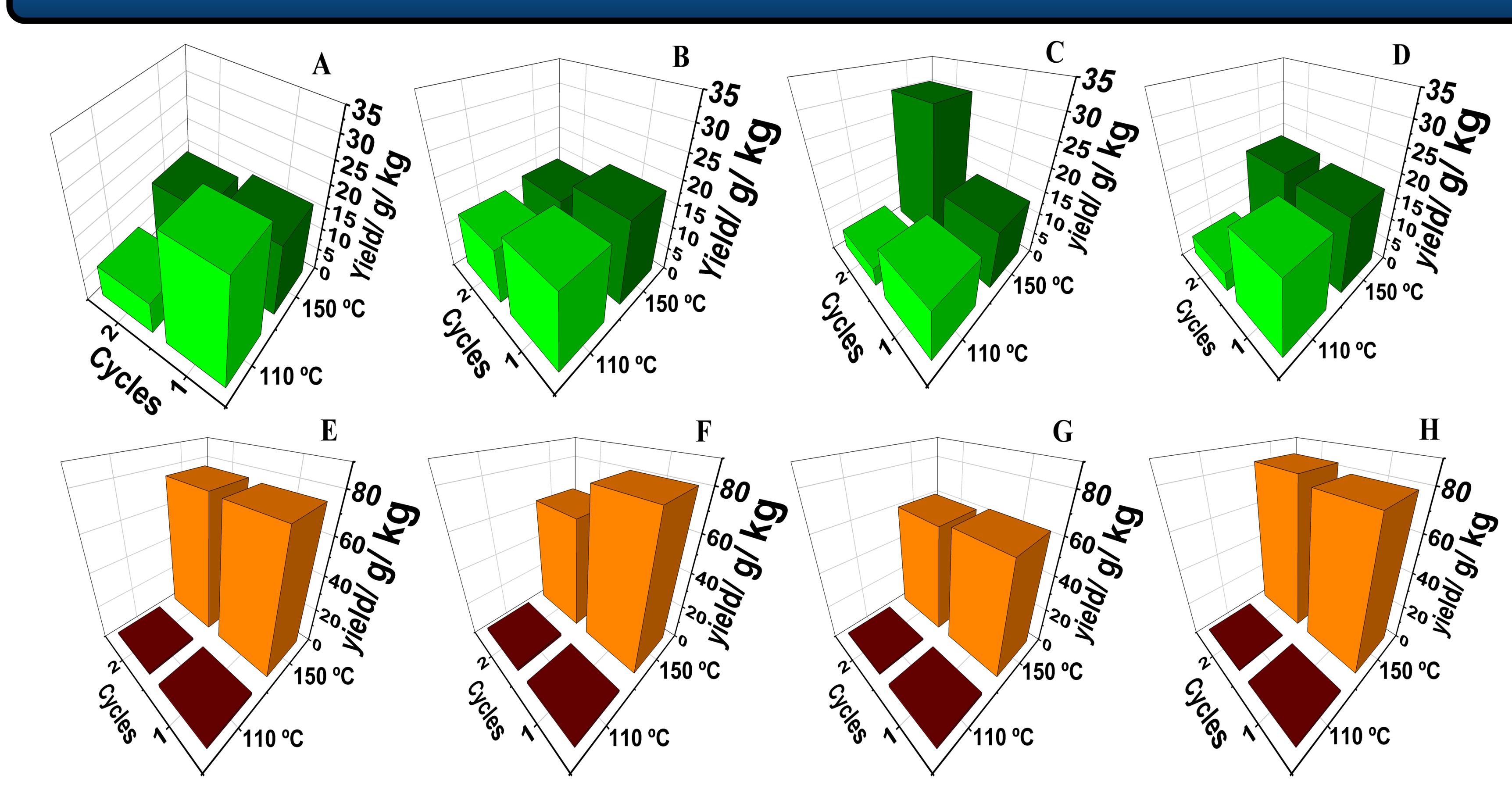



**Figure 1**. Xylose (A-D) and Furfural (E-H) productivity at 110 and 150 °C after treatments A/E: water, B/F: acetone, C/G: 2x acetone, D/H: calcinated.

**ANOVA for XYLOSE 0.01 Significance**

**110 ºC**

**A, C and D**: deactivation of catalyst's active sites. Variation between groups was significant.

**B**: efficient for catalyst regeneration. There was no significant difference between cycles.

**150 ºC**

**C**: anomalous behaviour for releasing xylose in cycle 2.

<u>**A, B and D**: efficient for reactivate catalyst's sites. There was no significant difference between cycles.</u>

Treatment A don't use neither toxic solvent nor electricity — **Pretreatment A 150 ºC** — catalyst recovery in direct catalysis with raw SCB

**ANOVA for FURFURAL 0.01 Significance**

**150 ºC** <u>**All pretreatments**: efficient for reactivate catalyst's sites. No significant difference between cycles</u>

**110 ºC** **All pretreatments**: low furfural production. Dehydration from xylose not thermodynamically favorable.

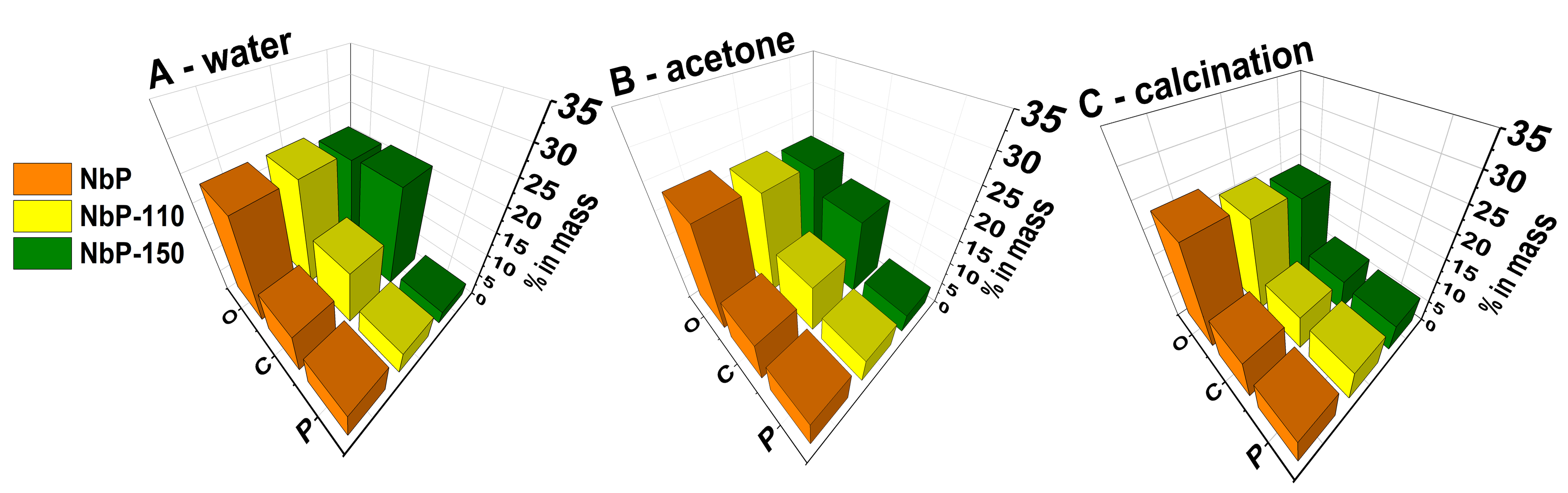



**Figure 2**.Elemental analysis of oxygen (O), carbon (C), and phosphorus (P) of the catalyst in different pretreatments by XEDS

**SEM images**

**Pure NbP** — We observed larger particle size and disaggregated particles — Pretreatment (Except for water at 150 ºC) → Particle size decrease, More aggregated particles — Larger surface area

**XEDS**

**Carbon present after catalyst calcination** — carbon strip glue

**All pretreatment** — Oxygen and P decreases → Slightly lost of active sites to solution. Carbon increases except calcination → Humins formation.

**More significant increase in carbon at 150 °C** — greater catalyst activity for xylose dehydration to furfural, then, greater humin production.

## REFERENCES

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Mika L.T. et al., Chem. and Sustain..118, 505–613 (2018).

## CONCLUSION

- The study of the reuse of the heterogeneous catalyst $NbOPO_4.nH_2O$ in converting SCB into furfural was successfully carried out.
- The results showed that it was possible to produce furfural and reuse the catalyst even using raw SCB.
- At 150 °C, there was a more outstanding production of furfural and pretreatment carried out using only water is enough to regenerate the catalyst in at least one cycle.

## ACKNOWLEDGMENTS

FAPEMIG, CNPq, EMBRAER, CBMM, CAPES, Klabin, Suzano, BR Petrobras