

# L-IV | Influence of Temperature and Pressure on the Synthesis of Olefins and Alcohols using Co-based Catalysts

Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT, Osterfelder Strasse 3, 46047 Oberhausen, Germany  
 Johannes Dahlhues\*, Dr.-Ing. Heiko Lohmann, Andrea Wilmsen, Phone +49 208 8598-1759, johannes.dahlhues@umsicht.fraunhofer.de  
 Evonik Resource Efficiency GmbH, Rodenbacher Chaussee 4, 63457 Hanau-Wolfgang, Germany  
 PD Dr. rer. nat. Dorit Wolf

In subproject L-IV, the conversion of synthesis gas (derived from steel mill gases) into olefins and higher alcohols is investigated. The primary objective is to identify a suitable process window and to investigate the influence of pressure and temperature. For this purpose, new Co-based catalyst systems are being developed and tested in cooperation between industrial and academic partners: The synthesis of the catalysts is carried out by Evonik, while testing is performed at Fraunhofer UMSICHT. Representative results on a selected catalyst are presented in more detail below.

## EXPERIMENTAL SETUP

- Catalyst used: Co/Mn–C catalyst, provided by Evonik
- Operation modes for testing:
  - Temperature range from 160 °C to 220 °C
  - Pressure of 30 bar to 50 bar
  - TOS up to 650 h
  - Feed gas H<sub>2</sub>/CO/N<sub>2</sub> (40/40/20 vol.-%)
  - Particle diameter 250–500 µm, 400 mg catalyst
  - GHSV of 4800 h<sup>-1</sup>

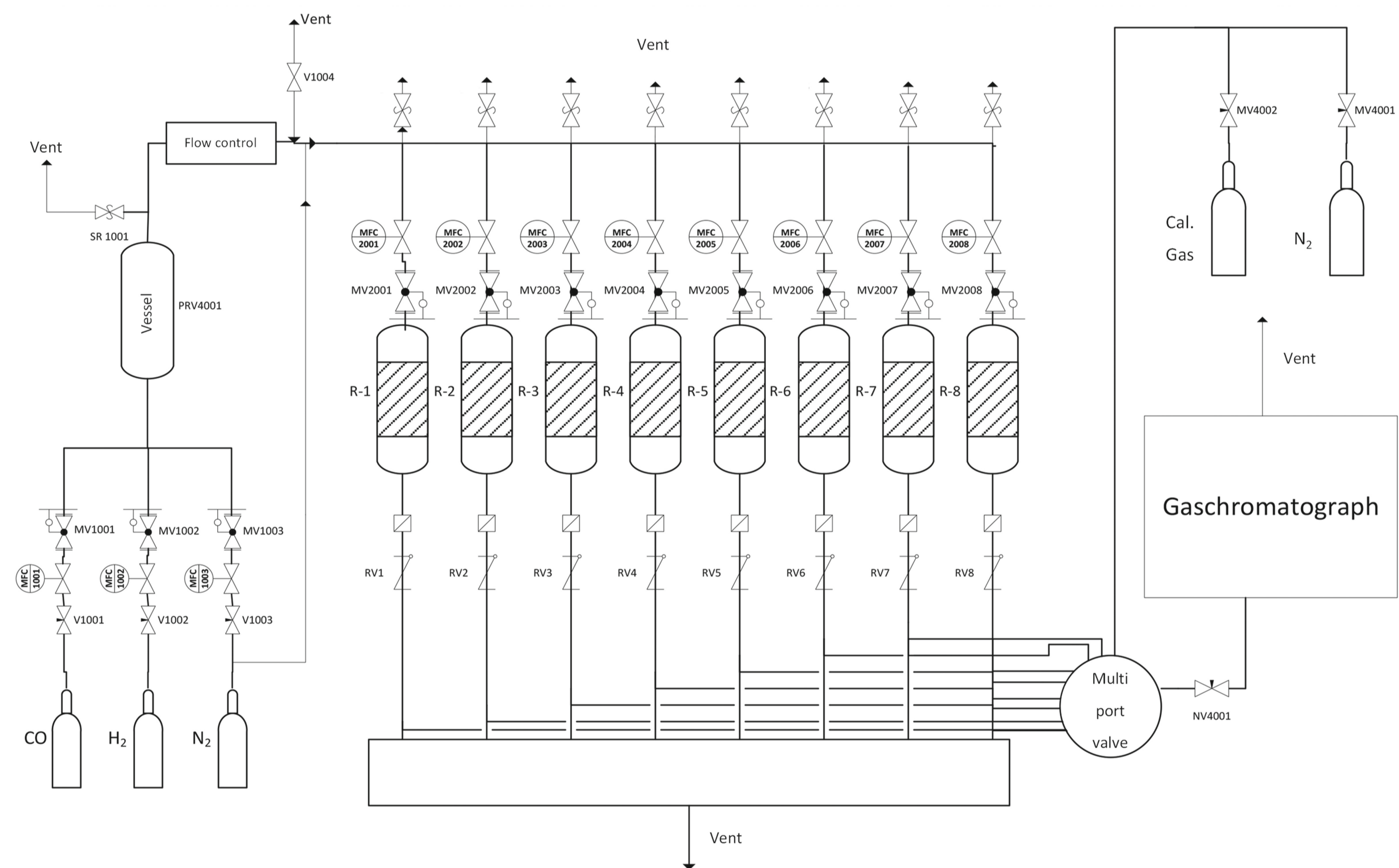


Fig. 1: Flowsheet of the "Spider-Reactor" setup

## SUMMARY AND OUTLOOK

- In accordance to literature<sup>[1–3]</sup> an increase of pressure and temperature leads to higher selectivity of olefins and alcohols > 50 %
- Other potential value products such as aldehydes are formed
- However, further investigation and characterization of the catalysts are necessary to minimize the formation of by-products

## RESULTS

Even at the comparatively low reactor temperature of 200 °C, an increase in pressure from 30 bar to 50 bar leads to a positive effect on the conversion and product selectivity.

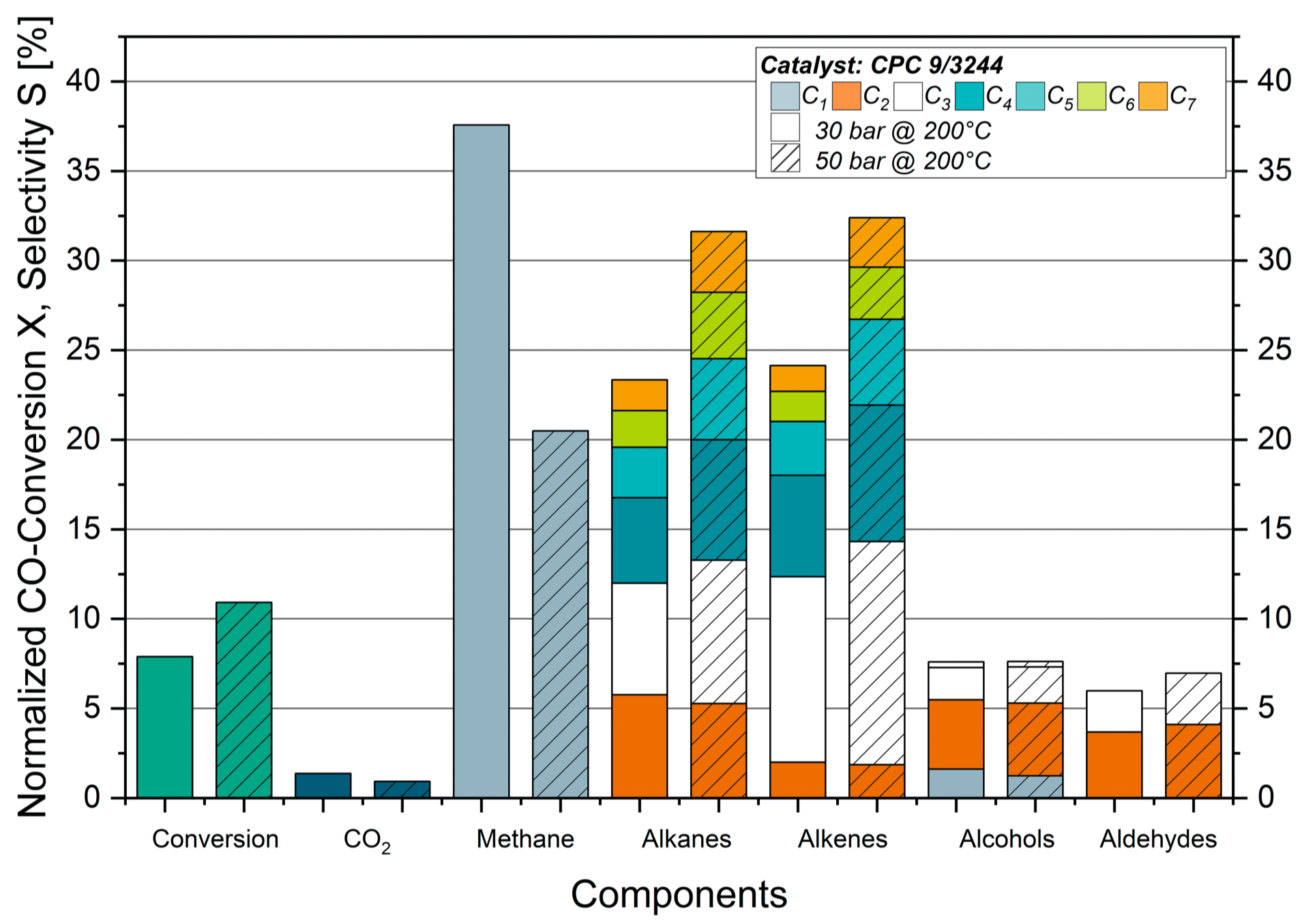


Fig. 2: Influence of the pressure increase on conversion and selectivity at 200 °C of the catalyst CPC 9/3244

The increase in temperature from 200 °C to 220 °C at a pressure of 50 bar additionally increases the conversion. At the same time, the selectivity to undesired by-products such as methane decreases, while the selectivity to the target products increases.

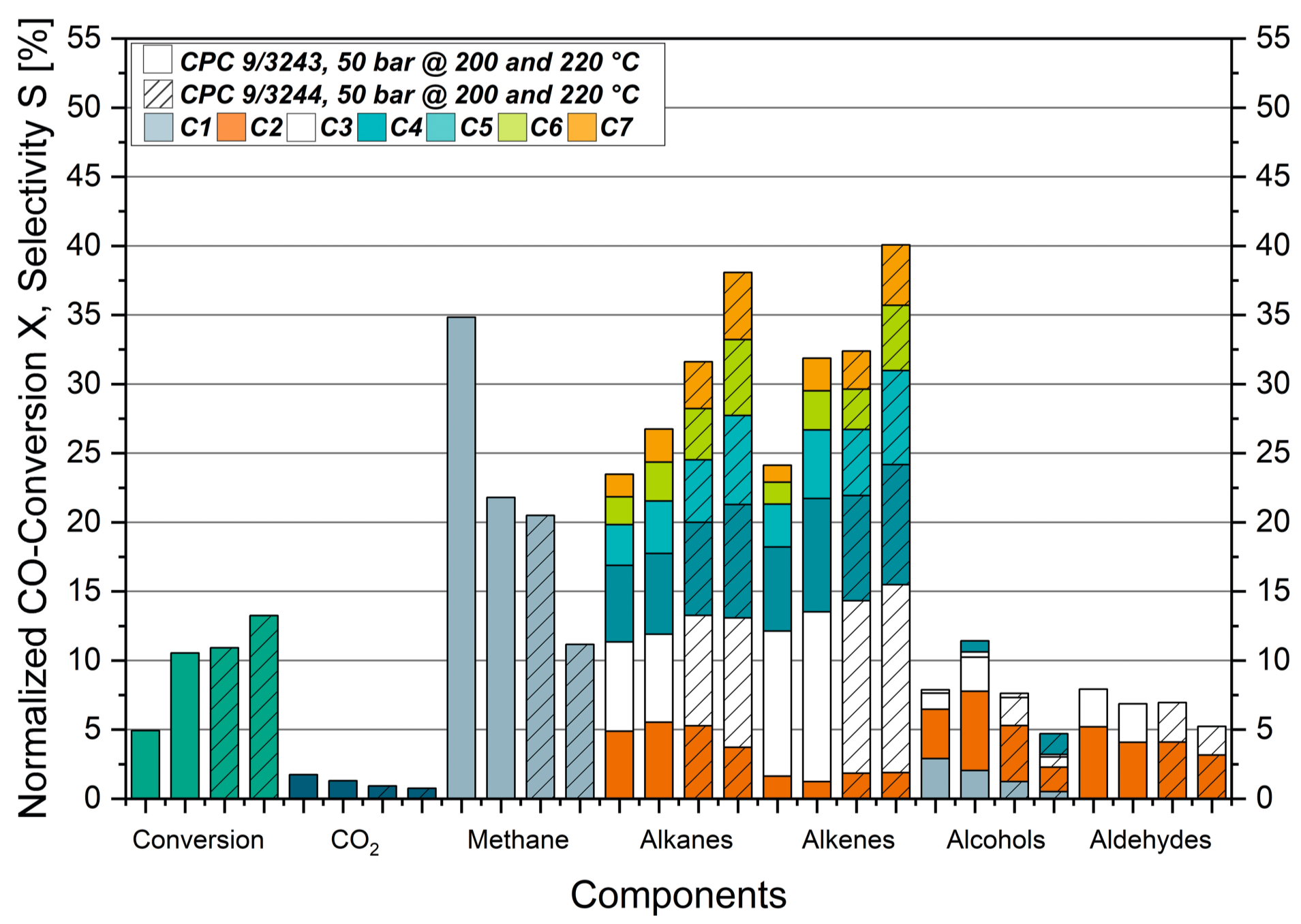


Fig. 3: Influence of the temperature increase on conversion and selectivity at 50 bar of the catalyst CPC 9/3243 and -44

### References

- [1] Z. Zhao et al. ACS Catal. 2018, 8, 228–241
- [2] T. Wiesmann, A. Reinsdorf, H. Lohmann and D. Wolf, Chem. Ing. Tech. 2020, 92, No. 10, 1459–1466
- [3] A. Dinse et al. Journal of Catalysis 2012, 288, 104–114

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