

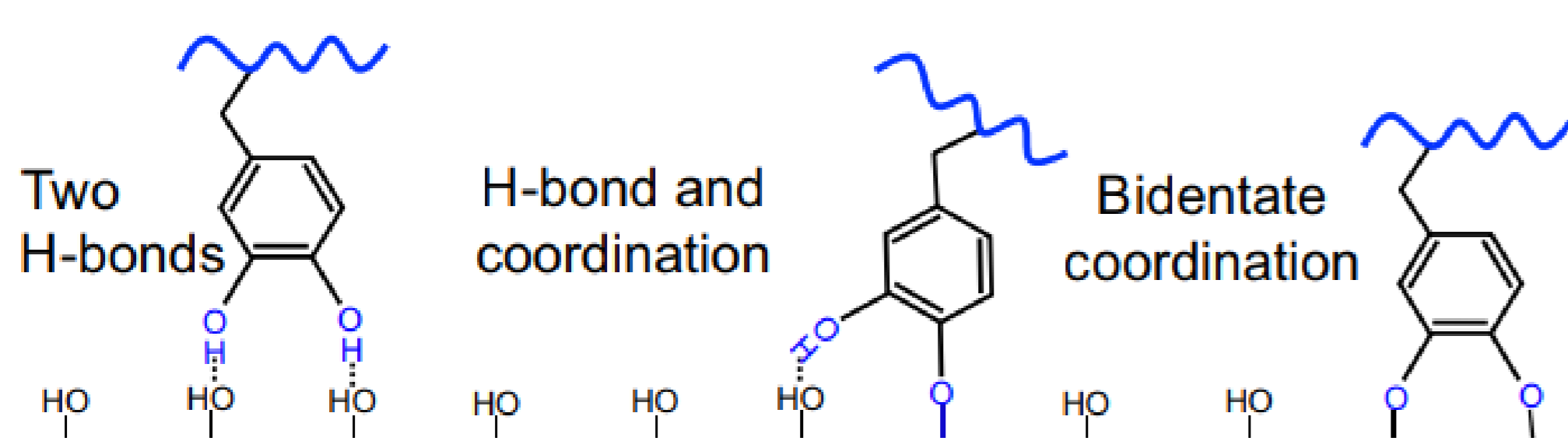
Bioadhesive

Synthesis of a biogenic adhesive by modification of chitosan with 3,4-dihydroxybenzoic acid.

L. Braun, J. Tix, N. Tippkötter
Bioprocess Engineering and Downstream Processing
University of Applied Sciences Aachen, Campus Jülich

Introduction

- Established adhesive systems are predominantly based on a petrochemical base
- The adhesive presented is completely biogenic in terms of raw materials and manufacturing chain
- Chitosan is used as an alternative renewable raw material
- Chitosan is a derivative of the waste material chitin. This is produced in bulk in crustacean processing and insect farms
- Based on the adhesion of mussels to surfaces, 3,4-dihydroxybenzoic acid is bound to the chitosan backbone
- 3,4-Dihydroxybenzoic acid is found in plants such as olives, pecans and nettles



Methodology

- Chitosan is functionalized with 3,4-dihydroxybenzoic acid under acidic or enzymatic catalysis of laccases
- Curing of the adhesive for 48 hours on different surfaces such as cardboard, wood, plastic, aluminum
- Carrying out a tensile test to determine the adhesive force

Result | Aluminium

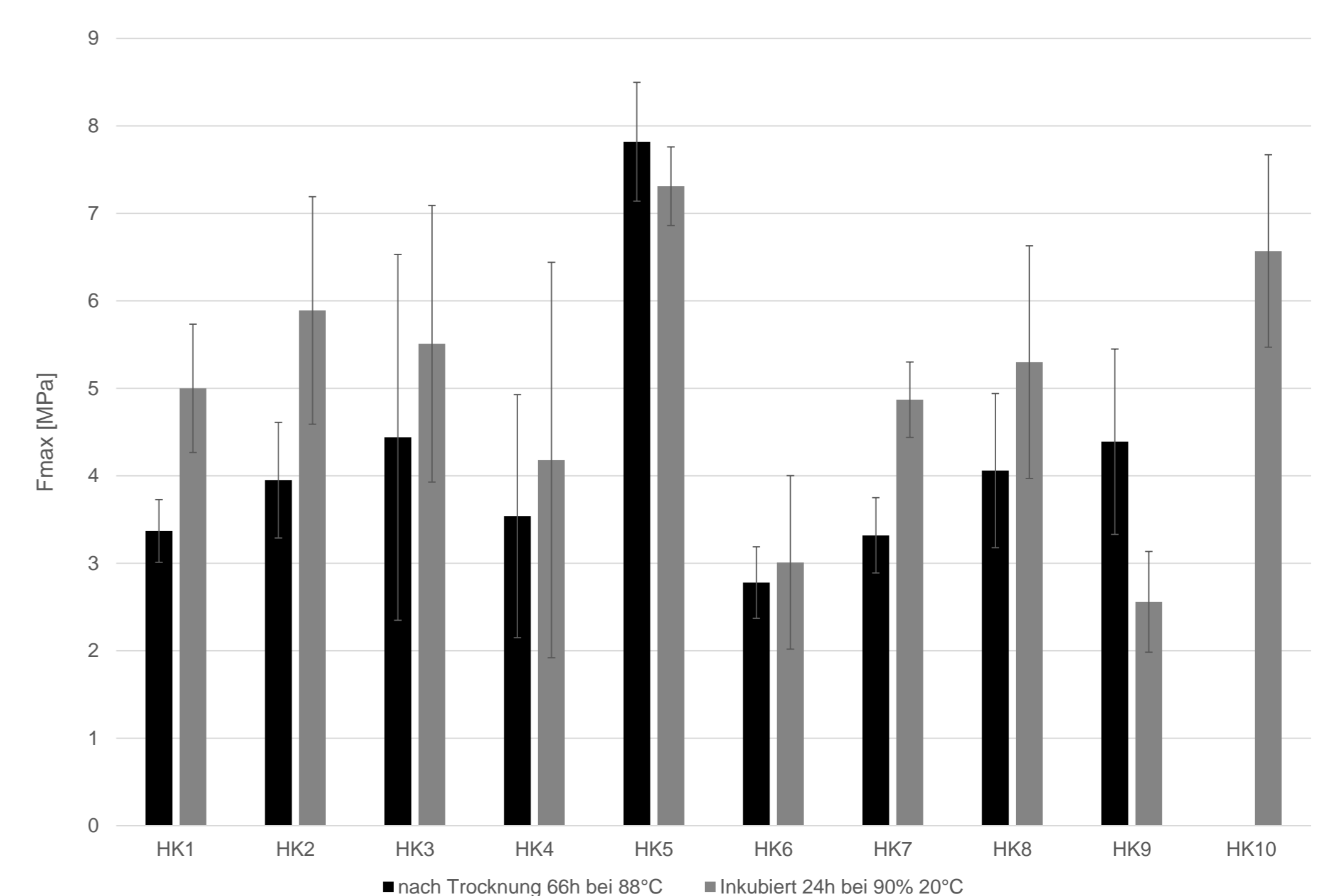
- Curing at 100 °C
- Adhesive force up to 2.84 MPa

Result | Cardboard

- Curing possible at room temperature
- Adhesive force >1.2 MPa
- Adhesive force measurement limited by cardboard material failing

Result | Wood

- Adhesive force up to 6.5 MPa



Results of adhesion force measurement of various specimens HK1-HK10; HK5 is a commercial petrochemical reference "Ponal Waterproof". Samples were dried for 66 h at 88 °C in drying oven. Then incubated for 24 h at 90% humidity and 20 °C.

Result | Plastic

- Adhesive force up to 1.1 MPa (PVC)
- Strongly dependent on the type of plastic
- Longer curing leads to better adhesion

Summary | Outlook

- A fully biogenic, compostable adhesive was successfully developed
- Competing commercial adhesives only achieve 3 to 4 MPa for wood
- Interesting for cardboard, adhesive strength exceeds the material thickness of all cardboard tested
- Not yet competitive for aluminum, superglues reach 5.5 MPa
- For plastics rather limited adhesion, but plastics are generally poor to bond
- Moisture resistance is limited and still needs to be improve