Debottlenecking Biorefineries – Solutions for Economic Feasibility

Sami-Pekka Rantanen, Sales Director

12.10.2020

METGEN AT A GLANCE

- **12 years old SME, 27 employees**. Offices and pilot facility in Kaarina, Finland and Geleen, Netherlands.
- MetGen's core competencies are protein engineering, microbiology, and industrial biotechnology.
- MetGen offers tailor-made bio-based solutions: enzymes, technology licenses, and R&D projects for new enzymatic solutions.
- MetGen aims to significantly contribute to the economics and sustainability of process industries such as pulp & paper, biofuels, and biochemicals.
- Owns a technology platform to create and supply of new enzymes in a very large industrial scale.
- Strong IP portfolio.
- Wide collaboration network & the preferred enzyme developer in EU Horizon 2020 projects.
- To this date, MetGen has been awarded in total 12.7 M€ as EU H2020 grants for 11 ambitious projects.
- MetGen has been recognized by Frost & Sullivan with Best Practices Award for Enzyme Technologies and Millennium Award for Synthetic Biology.

THE BIG PICTURE: HAVE A BIOREFINERY AND MAKE IT WORK

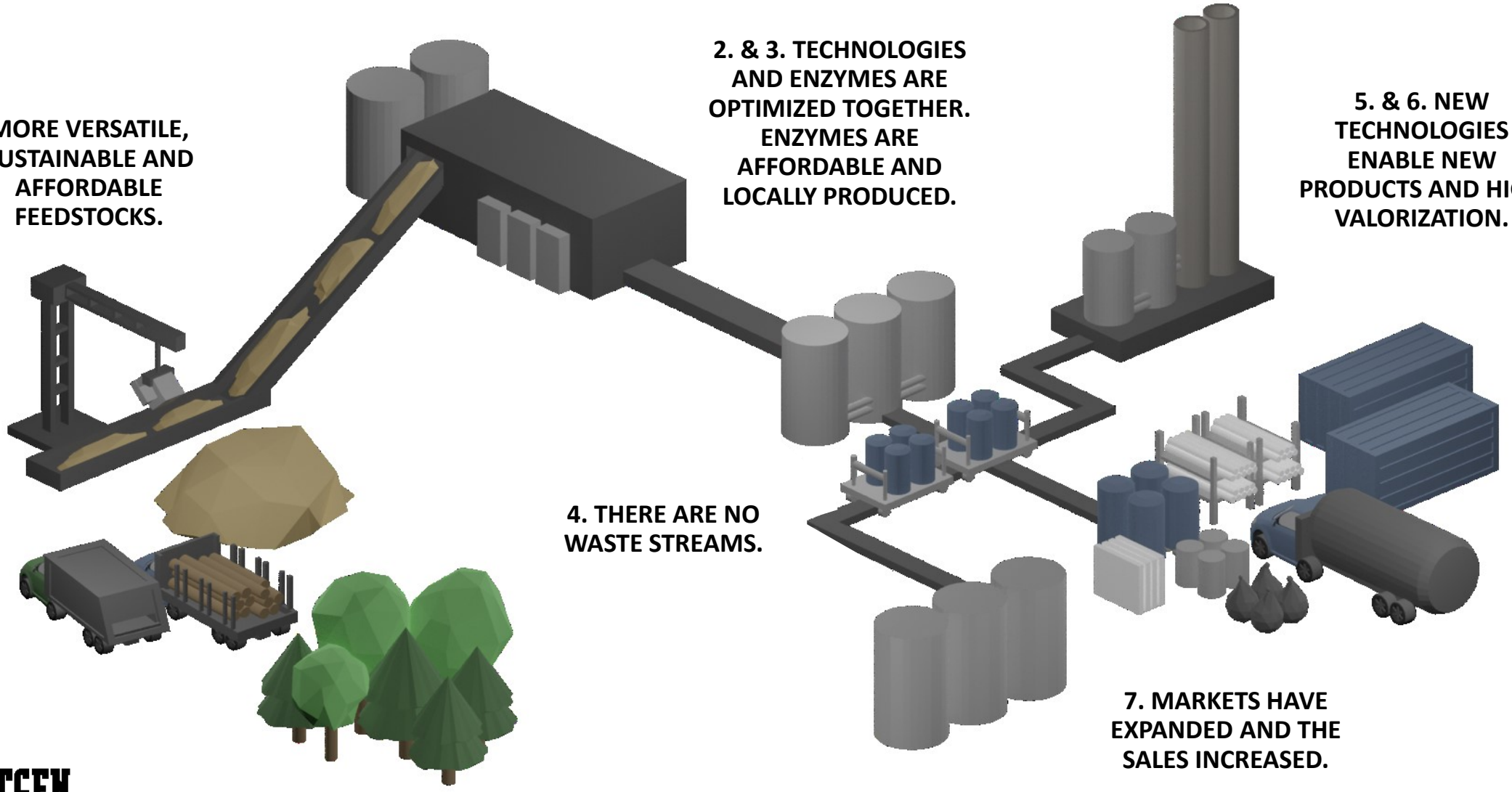
1. MORE VERSATILE, SUSTAINABLE AND AFFORDABLE FEEDSTOCKS.

2. & 3. TECHNOLOGIES AND ENZYMES ARE OPTIMIZED TOGETHER. ENZYMES ARE AFFORDABLE AND LOCALLY PRODUCED.

4. THERE ARE NO WASTE STREAMS.

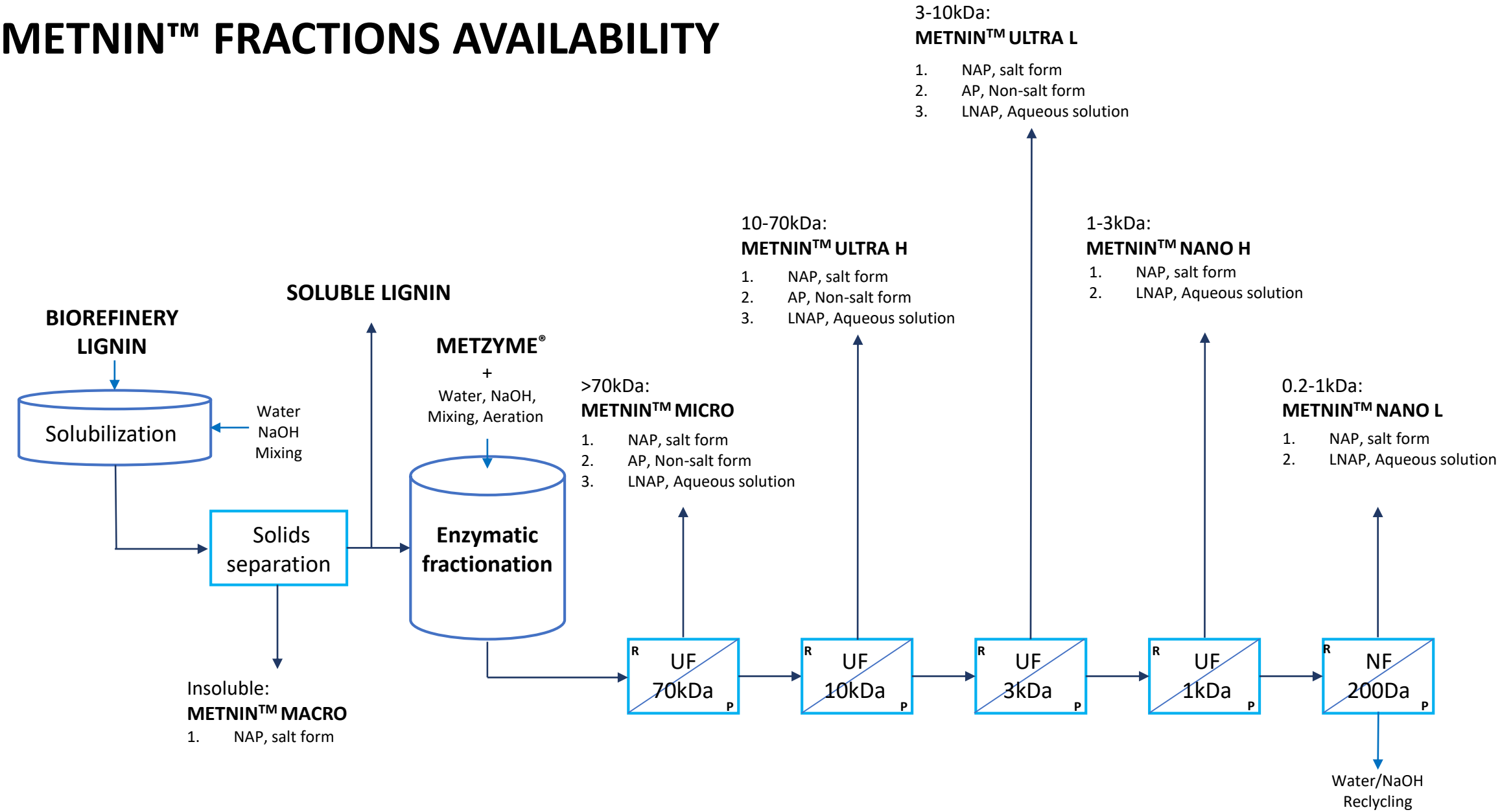
5. & 6. NEW TECHNOLOGIES ENABLE NEW PRODUCTS AND HIGH VALORIZATION.

7. MARKETS HAVE EXPANDED AND THE SALES INCREASED.



METGEN

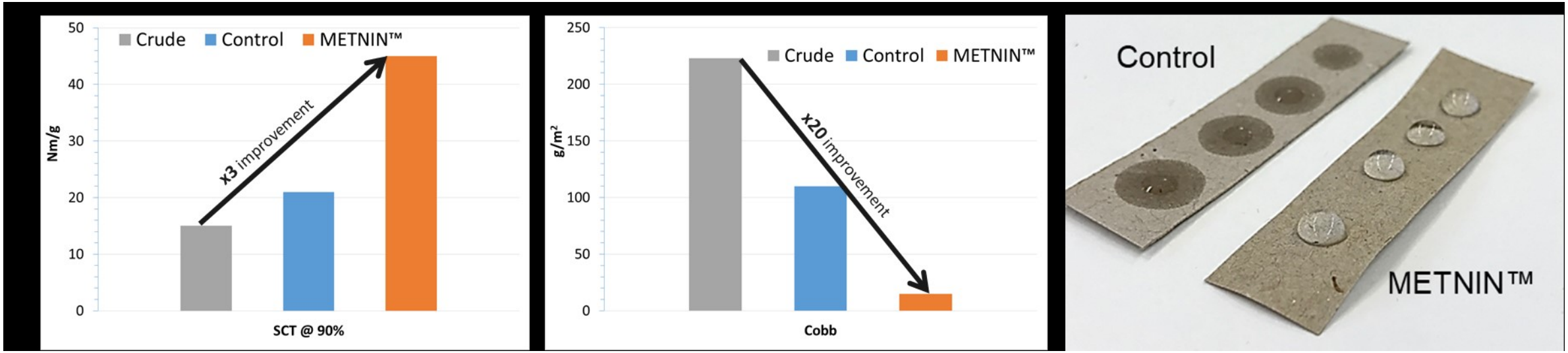
METNIN™ FRACTIONS AVAILABILITY



NAP: Non acid precipitated
AP: Acid precipitated
LNAP: Liquid non acid precipitated

New patent application related to lignin filed: METHOD FOR MAKING MOISTURE-RESISTANT PAPER

Lignin sizing formulations, example of results with SWEETWOODS lignin



SCT @ 90% values refers the moisture resistance capacity.

Cobb's value refers to the water uptake after 60 s.

METNIN™ formulations can improve the quality of several furnishes used in packaging

		Hardwood METNIN™ fractions*	Softwood METNIN™ fractions*
Improvement (%) vs. reference **Low moisture (50%)**	OCC	35-42	55-84
	NSSC	12-17	29-55
	UBSK+RCF	12-16	46-50
Improvement (%) vs. reference **High moisture (90%)**	OCC	37-40	58-75
	NSSC	14-18	17-34
	UBSK+RCF	19-23	41-45
Cobb60** **(g/m²)**	OCC	34-61	29-68
	NSSC	19-47	39-72
	UBSK+RCF	26-30	44-48

*Data derived from 350 trial points

**outliers included in average calulation induced high variation

- All furnishes strength and humidity resistance can be improved by applying METNIN™ formulations.
- The improvement seen in low moisture is maintained when incubated at high moisture environment.
- Cobb values of the packaging material made are in the range of commercial requirements

METGEN

METNIN® SHIELD™ – Creep resistance of packaging board

Target: Provide creep resistance in high humid conditions (RH 90%), improve strength (SCT) and sizing (Cobb60) i.e. hydrophobicity for packaging paper.

METNIN® SHIELD™ Fraction >70kDa for creep resistance application in packaging.

Production of packaging board (OCC) test liner was made by spraying METNIN™ SHIELD before press section of the paper machine (≈40% paper dryness) :

Application and tests conducted by:
ICP Pulp and Paper Institute, Ljubljana Slovenia.

METGEN

METNIN™ SHIELD – Creep resistance of packaging material, results

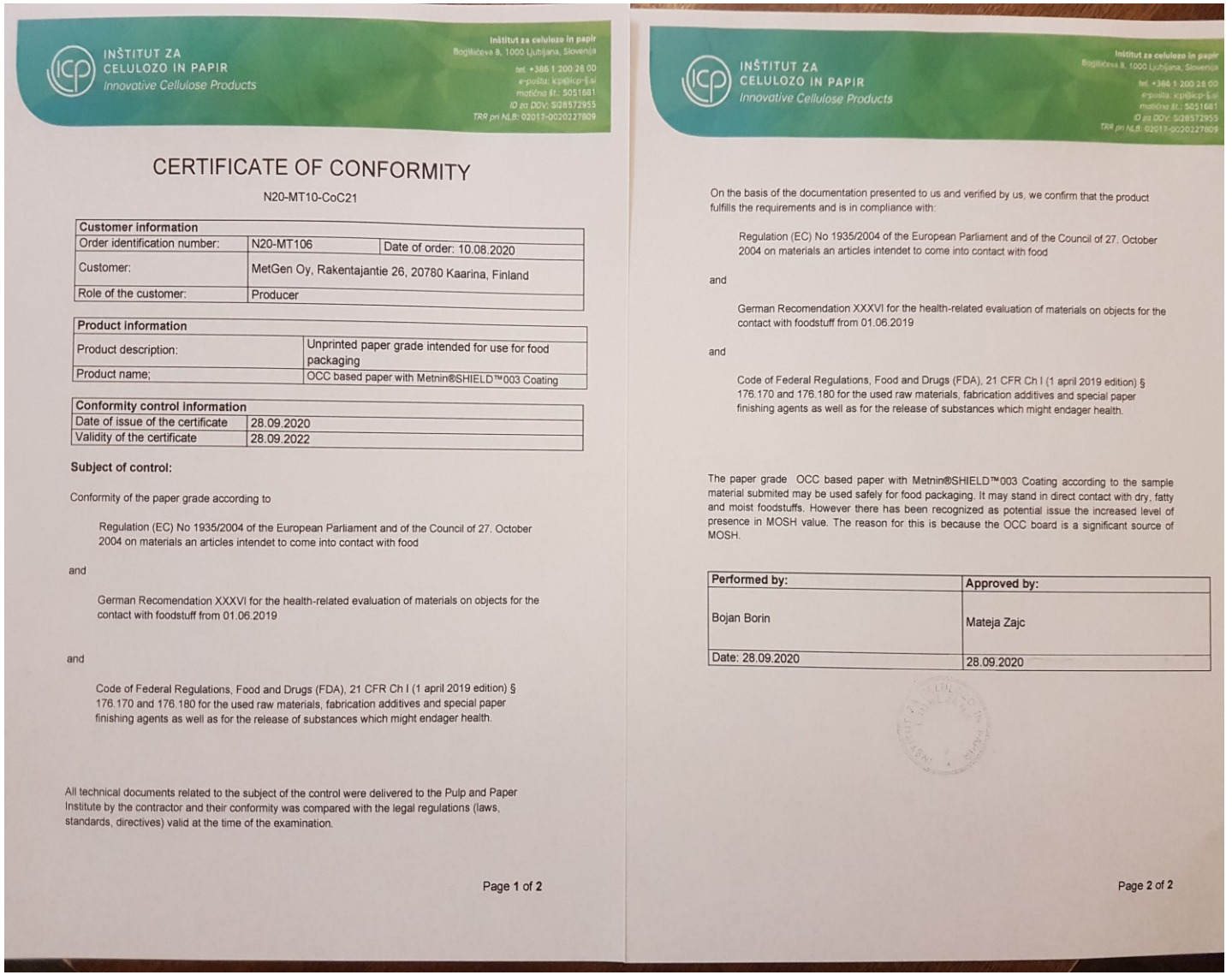
- MetGen's formulation improves resistance of paper to water penetration (sizing): improvement by a factor 10 compared to the non-coated sheet.
- 23 % improvement for SCT at 50% RH.
- 47 % improvement for SCT at 90% RH.
- Notably, the strength value of coated sheet measured at 90% RH corresponds to the strength value of non-coated sheet measured at 50% RH.
- Box compression Test (BCT) showed an increase of 16% of the coated boxes as compared to boxes made with reference papers.

METGEN

METNIN™ SHIELD – Creep resistance of packaging board, regulatory

Packaging Board treated with Metnin®SHIELD™ certified compliance with

- Regulation (EC) No 1935/2004 on materials and articles intendet to come into contact with food.
- German Recommendation XXXVI for health related evaluation of materials food food.
- Code of Federal Regulations, Food and Drugs (FDA), 21 CFR Ch I § 176.170 and 176.180.
- 100% recyclable.



INŠTITUT ZA CELULOZO IN PAPIR
Innovative Cellulose Products

Inštitut za celulozo in papir
Bogišičeva 8, 1000 Ljubljana, Slovenija
tel: +386 1 200 26 00
e-pošta: icp@icp-lj.si
matična št.: 5051681
ID za DDV: SI28572955
TRR pri NLB: 02013-0020227809

CERTIFICATE OF CONFORMITY

N20-MT10-CoC21

Customer information		
Order identification number:	N20-MT106	Date of order: 10.08.2020
Customer:	MetGen Oy, Rakentajantie 26, 20780 Kaarina, Finland	
Role of the customer:	Producer	

Product information	
Product description:	Unprinted paper grade intended for use for food packaging
Product name;	OCC based paper with Metnin®SHIELD™003 Coating

Conformity control information	
Date of issue of the certificate	28.09.2020
Validity of the certificate	28.09.2022

Subject of control:

Conformity of the paper grade according to

Regulation (EC) No 1935/2004 of the European Parliament and of the Council of 27. October 2004 on materials an articles intendet to come into contact with food

and

German Recomendation XXXVI for the health-related evaluation of materials on objects for the contact with foodstuff from 01.06.2019

and

Code of Federal Regulations, Food and Drugs (FDA), 21 CFR Ch I (1 april 2019 edition) § 176.170 and 176.180 for the used raw materials, fabrication additives and special paper finishing agents as well as for the release of substances which might endager health.

All technical documents related to the subject of the control were delivered to the Pulp and Paper Institute by the contractor and their conformity was compared with the legal regulations (laws, standards, directives) valid at the time of the examination.

Page 1 of 2

INŠTITUT ZA CELULOZO IN PAPIR
Innovative Cellulose Products

On the basis of the documentation presented to us and verified by us, we confirm that the product fulfills the requirements and is in compliance with:

Regulation (EC) No 1935/2004 of the European Parliament and of the Council of 27. October 2004 on materials an articles intendet to come into contact with food

and

German Recomendation XXXVI for the health-related evaluation of materials on objects for the contact with foodstuff from 01.06.2019

and

Code of Federal Regulations, Food and Drugs (FDA), 21 CFR Ch I (1 april 2019 edition) § 176.170 and 176.180 for the used raw materials, fabrication additives and special paper finishing agents as well as for the release of substances which might endager health.

The paper grade OCC based paper with Metnin®SHIELD™003 Coating according to the sample material submited may be used safely for food packaging. It may stand in direct contact with dry, fatty and moist foodstuffs. However there has been recognized as potential issue the increased level of presence in MOSH value. The reason for this is because the OCC board is a significant source of MOSH.

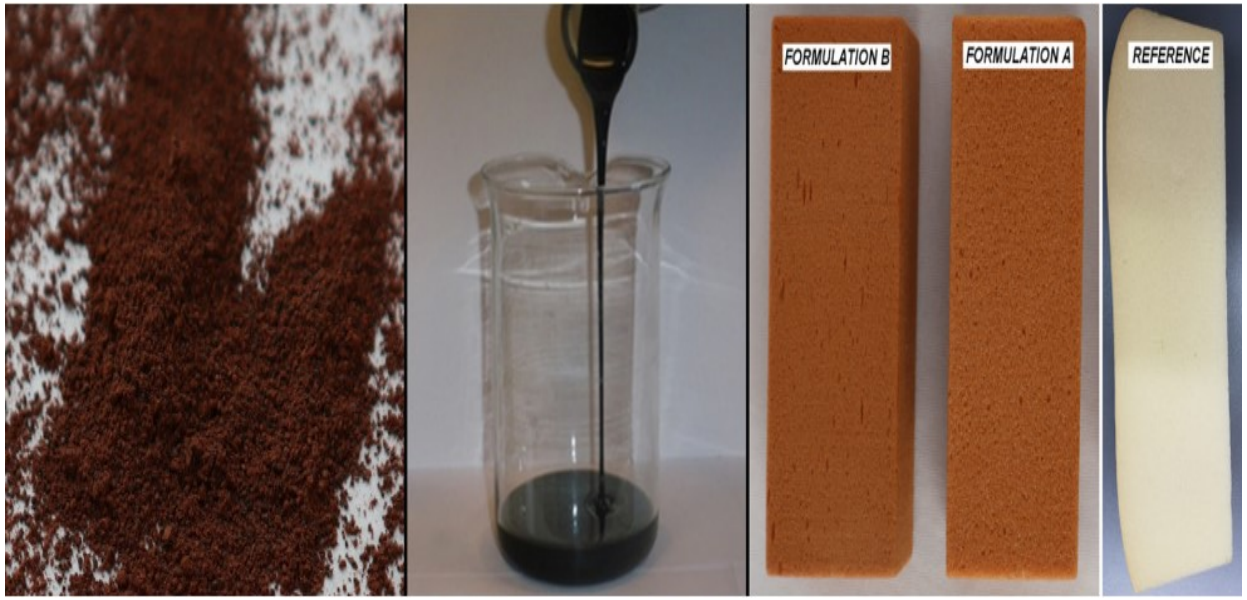
Performed by:	Approved by:
Bojan Borin	Mateja Zajc
Date: 28.09.2020	28.09.2020

Page 2 of 2

METGEN

POLYURETHANE FOAMS – COMMERCIAL POLYOL REPLACEMENT WITH LIGNOPOLYOLS

- The tested lignins:
  - Crude BioPiva395
  - Crude Lignoboost lignin
  - Metnin ULTRA L
  - Metnin ULTRA H
- **Rigid PU foams with unmodified lignin – 12 formulations tested**
- **Liquefaction and chemical modification of lignin, characterization and formulation**
- **Rigid foam testing of liquefied lignins and lignin polyols –36 formulations tested**

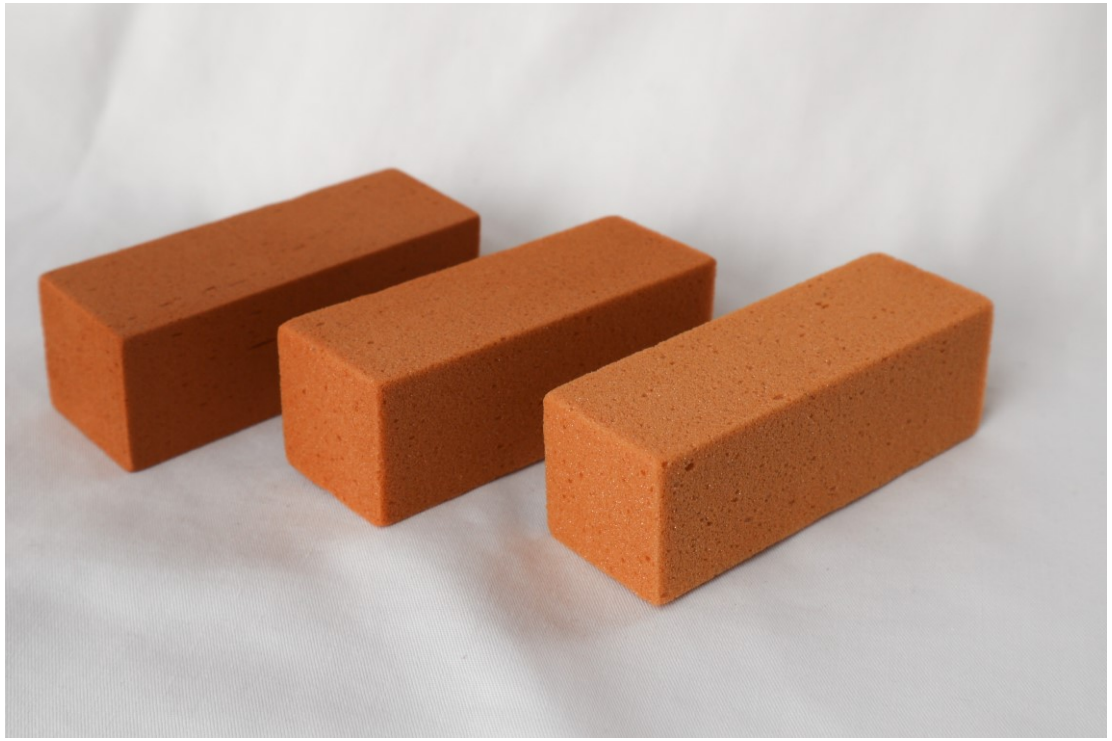


POLYURETHANE FOAMS – METNIN™ IMPACT ON POLYURETHANE PROPERTIES

- METNIN™ ULTRA L decreases water absorbtion
  - 50 % vs commercial Polyurethatne
  - 20 % vs crude lignin
  - 13 % vs commercial lignopolyol

- METNIN™ ULTRA L Improves flame retardance
  - 75 % vs commercial Polyurethatne
  - 83 % vs crude lignin
  - 87 % vs commercial lignopolyol

- Other parameters equal to commercial polyurethane.



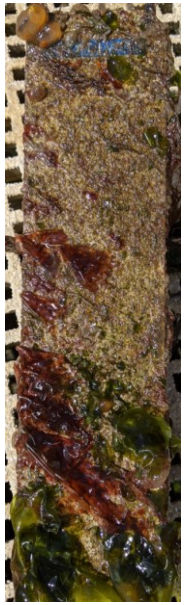
METGEN

ANTIFOULING APPLICATIONS, set-up and results

MetGen assessed the potential for lignin fractions as antifouling agent for marine paint.

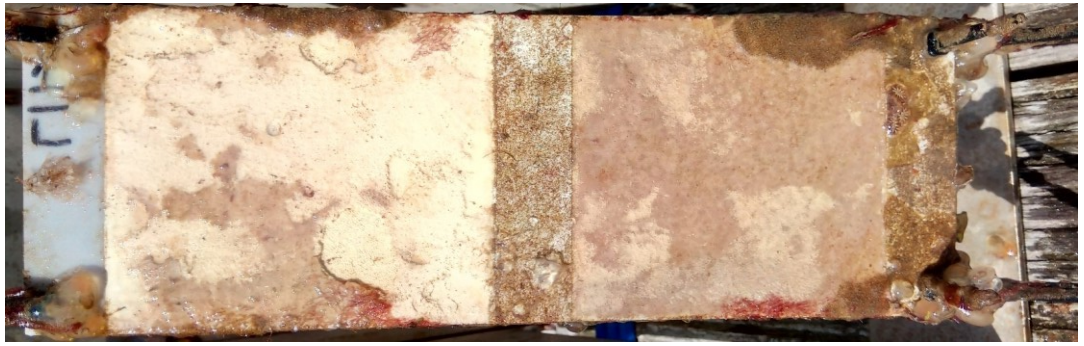
Panels were coated with lignin fractions included in paint formulation and immerge for 4 months in the test site of the Centre for Marine Biofouling and Corrosion (https://biofoulingcorrosion.co.uk/)

Control Panel STT C1 Inward facing, 16 weeks



Control Panel STT C1 Outward facing, 16 weeks

Lignin coated, Outward facing, 16 weeks



Lignin coated Inward facing, 16 weeks

Lignin coated, at start

OTHER APPLICATIONS – RESULTS PENDING

- Plywood applications
- Medium Density Fibreboard

METGEN

ACKNOWLEDGEMENT OF PUBLIC EU H2020 FUNDING

These projects have received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreements No: SWEETWOODS (792061), WoodZymes (792070), UNRAVEL (792004), BIOrescue (720708), BIOFOREVER (720710). FALCON and ButaNexT have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No (720918) and (640462). APEX has received funding from the European Union's Horizon 2020 SME-instrument under grant agreement No (666346).

MetGen – the friendly enzyme company invites you to join in the bio-based industry revolution.