New insights into the structure and composition of technical lignins: a comparative characterisation study

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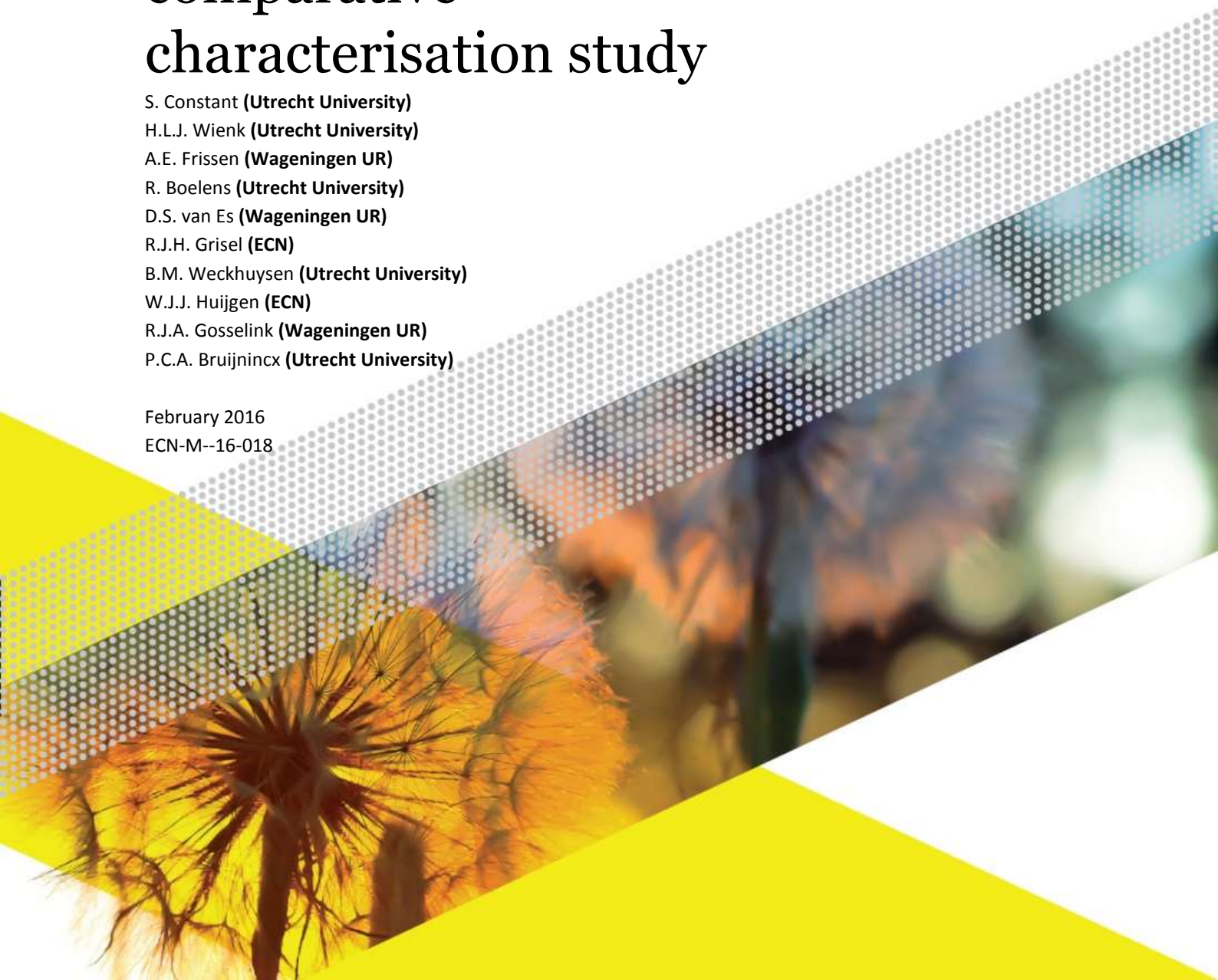

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The structure of isolated, technical lignins is known to depend heavily on both the biomass source as well as the pretreatment or pulping process from which the lignin originates [1]. To illustrate this, six lignins have been extensively characterised using a multitechnique approach, covering hardwood, softwood and grass lignins obtained by three common (industrial) isolation methods Kraft, Soda and organosolv pulping. These technical lignins were comprehensively characterized by quantification of the Klason lignin content, sugar content, ash content and elemental analysis [2]. A comparison of nine SEC methods, including for the first time commercial alkaline SEC columns, provided information on the lignin molar mass. The chemical structure of the lignins was studied with an extensive NMR analysis including ^{31}P NMR, HSQC 2D NMR. The latter has indeed proved particularly insightful for the general understanding of the structure of native-like lignins [3]. In addition, standardization of protocols and an assessment of inter-laboratory reproducibility of the results was was also central to this effort. Structure identification and quantification of the aromatic units and inter-unit linkages indicated that all technical lignins, including the organosolv ones, are considerably degraded and condensed by the pulping process conditions. Importantly, very low amounts of β-aryl ether linkages were found compared to other, milder lignin isolation processes [4]. Stilbene and ether furfural units could also be identified in some of the lignins. Taken together, the insights gained in the structure of the

technical lignins, in particular the low aryl ether contents, carry implications for the design of lignin valorisation strategies either by catalytic depolymerisation or by materials application.

[1] Xu, F., Sun, J.X., Sun, R.C., Fowler, P., and Baird, M.S., Ind. Crops Prod., 23, 180-193 (2006).
[2] S. Constant, H.L.J. Wienk, A.E. Frissen, P. de Peinder, D.S. van Es, R. Boelens, R.J.H. Grisel, B.M. Weckhuysen, W.J.J. Huijgen, R.J.A. Gosselink, and P.C.A. Bruijnincx, submitted.
[3] J.C. del Río, J. Rencoret, P. Prinsen, A.T. Martinez, J. Ralph, and A. Gutiérrez, J. Agric. Food Chem. 60, 5922-5935 (2012).
[4] H. Heikkinen, T. Elder, H. Maaheimo, S. Rovio, J. Rahikainen, K. Kruus and T. Tamminen, J. Agric. Food Chem., 62, 10437–10444 (2014).

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