

Supervisor's opinion on the PhD. thesis

**“Dialdehyde cellulose preparation, characterization and utilization as
crosslinking agent for poly(vinyl alcohol) hydrogels”**

by

Lukáš Münster

submitted to the

Tomas Bata University in Zlin

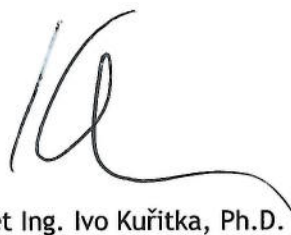
Ing. Lukáš Münster studied in the Study course ‘Technology of Macromolecular Compounds’ in the Ph.D. programme ‘Chemistry and materials technology’ at the Centre of Polymer Systems, Tomas Bata University in Zlín, Czech Republic. Within his studies, he has fulfilled all duties connected with the study programme and successfully passed the state exam in 2017. His dissertation work is focused on modification of cellulose by a relatively mild periodate oxidation of the vicinal hydroxyl groups attached to C2 and C3 carbon atoms resulting into the cleavage of the respective bond and formation of dialdehyde cellulose (DAC) polymer. The main aim is to utilize DAC as a macromolecular alternative to low molecular chemicals for crosslinking of polymers bearing hydroxyl side groups to prepare hydrogels, e.g. from poly(vinyl alcohol) (PVA). Due to macromolecular character of DAC, it is considerably less toxic than its low molecular counterparts used nowadays, such as glutaraldehyde (GA). Prepared DAC is insoluble in water under laboratory conditions and needs to be solubilized prior crosslinking of PVA dissolved in water. However, the solubilization process results into severe degradation of DAC macromolecules and obtained solution is highly instable and the average molecular weight of DAC decreases with time rapidly hand in hand with the decrease of reactive aldehyde groups content which corresponds to decay of its crosslinking ability. Lukáš studied this process and investigated stabilization of solubilized DAC by low pH. Prolongation of its shelf life above 28 days was achieved. He was the first who analysed comprehensively composition and chemical structure of the solubilized and stabilized DAC. Further, he analysed with the same care changes occurring in such solutions during aging. Prepared DAC solutions were successfully utilized for preparation of hydrogels and superiority of DAC over GA was demonstrated even at very low concentration. Moreover, DAC forms denser network with PVA at high concentrations and principally different network topology compared to GA. This enables to prepare hydrogels with wide range of controllable properties. Hence the application potential of these newly developed materials in medical and pharmaceutical branches is evident.

Lukáš is a useful member of our group. The importance of his work is best manifested within the framework of our team research activities since it was a necessary prerequisite for further development of oxidised celluloses as drug delivery carries for cancer treatment. This research is performed in cooperation with Masaryk university in Brno and CEITEC within the framework of the

project 'Advanced Carriers for platinum drugs' (GA16-05961S) supported by the Czech Science Foundation and Lukáš gives 40 % of his capacity to the project tasks. Further research is planned in the field of DAC crosslinked hydrogels to obtain systems with controlled release of active species. Moreover, the range of investigated macromolecular substances will be extended to other biopolymers from the polysaccharide family. Functional derivatives suitable for pharmaceutical applications as drug carrier systems and wound dressing and healing will be prepared.

The overall scientific excellence and abilities of Lukáš Münster are best documented by the list of his publications. There are five papers in most renowned journals publishing his work, all ranked being in Q1. Besides that, three other papers of lesser importance have been published also. Lukáš presented his results on international conferences with fulltext contributions in proceedings too. He has experience from a number of project he took part on. During his study and work at the TBU in Zlín, Ing. Lukáš Münster has already demonstrated sufficient diligence, knowledge and effort necessary for successful accomplishment of doctoral study in the PhD. Programme.

With regard to these facts and according to my opinion, I recommend the Thesis to be defended and upon his presentation and successful defence and all further necessary considerations by the committee to award Mr. Münster the degree Doctor of Philosophy (Ph.D.).



Assoc. Prof. Ing. et Ing. Ivo Kuřitka, Ph.D. et Ph.D.

Supervisor

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