

External examiner's review of a Master's thesis

Student's name and surname:	Eyoel Legesse Teklemariam
Degree programme:	Environmental engineering
Degree course:	N0712A030002 Environmental Engineering
Specialization (if the degree course is divided into specializations):	
Department:	Department of Environmental Protection Engineering
Supervisor of the Master's thesis:	Ing. Štěpán Vinter, Ph.D.
External examiner of the Master's thesis:	Ing. Jaroslav Filip, Ph.D.
Academic year:	2023/2024

Title of the Master's thesis:
Biobleaching of electronic waste

Assessment of the Master's thesis using the ECTS grading scale:

Assessment criteria	Assessment according to the ECTS
1. Fulfilment of the assignment criteria	A – Excellent
2. Level of quality of the formal aspects of the thesis, including the level of linguistic quality	C – Good
3. Amount, topicality and relevance of the literature sources consulted	A – Excellent
4. Description of experiments and implementation methods	B – Very good
5. Level of quality of processing of the results	A – Excellent
6. Interpretation of the results achieved and discussion thereof	B – Very good
7. Formulation of the conclusion of the thesis	B – Very good

I recommend the submitted thesis for defence and propose the following assessment:

B – Very good

Comments on the Master's thesis:

The Master's thesis by Eyoel Legesse Teklemariam deals with extraction of valuable metals from discarded printed circuit boards by biological way, namely with *Acidithiobacillus ferrooxidans* bacteria. The theoretical part is conveniently focused on production, properties and impacts of such e-waste and on leaching and bioleaching methods. Facts are supported by appropriate references (grade A) and the formal quality of this part is rather good, except of issues such as: on page 22, concentration of metal in various devices' PCBs are given while in the following paragraph the same information is provided, but this time the values are different; "messy" numbering of chapters; inconsistency in text flow – section 1.1.1 (page 37, 38) should be placed in the part where e-waste properties are described (probably 1.4 or 1.1) and chapter "Metal toxicity" should be in chapter 1.3. Furthermore, incomplete, long sentences with unclear meaning were found throughout the text (no example given to keep this document brief). Unfortunately, the formal quality of the experimental part is lower, overall, formal aspects can be graded C. Experimental part provides description of methodology where several points should be explained in more details, for example: How the bacterial suspension for sample inoculation was prepared? It was from lyophilized powder or from a deep-frozen suspension? What is the composition of leaching media mentioned in the chapter 5.7.2? (Not to mention that the section title is "Bioleaching" but it is somehow merged with leaching). In section 5.8 "metal content determination in fine and coarse samples" is mentioned, but apparently the analysis was performed in the leaching medium, not in solid samples. The grade B.

The achieved results are presented in a concise way, they are appropriately supported by graphs and tables (although values discussed in the text are presented without confidence intervals "promised" in the section 5.11). The grade for this criterion can be A. The results were also discussed and compared to results reported elsewhere, although sometimes their description is not concise (e.g., on page 62 it is stated that Sn and Pb concentrations are relatively lower in both samples, showing higher values in coarse samples - lower relative to what?). The results are summarized in the conclusion which tends to be not so clear in certain parts. For example, the statement "Dust_A1 and Coarse_A2 samples revealed the highest concentrations of copper and nickel, with 74.8 and 100%, respectively" – first, it concentrations are in mg/kg, not in % (it is recovery); second – it is not clear what the values are respective to? To Ni and Cu or to sample 1 and sample 2? Regardless of these issues, the assignment criteria and the aims of the thesis were fulfilled (grade A) and the thesis is recommended to be submitted for defence.

Questions to be asked by the external examiner of the Master's thesis:

- 1) Can you compare results in the section 6.5 with literature? Have other authors observed similar dependence of *A. ferrooxidans* growth on sulphur concentration in the biomedium?
- 2) How did you choose the composition of the biomedium? Was it prepared according to some previous experiments or according to published studies?

In Zlín on **23. 05. 2024**

Signature of the external examiner of the Master's thesis