Doctoral School of Chemical Engineering and Material Sciences
University of Pannonia

Review of Doctoral (PhD) Dissertation
Opponent's Opinion for Final defence

Reviewer:	**Prof. Dr. habil. Hosam Eldin Bayoumi CSc**
Dissertation's Author:	**Roquia Ibrahim Saad Rizk**
Title of Dissertation:	**Advanced Comprehensive Water Quality Assessment r**

General description

1. **Physical-chemical parameters have been measured in water of lake Nasser and Lake Balaton.**
   - Fourteen water chemical parameters (Chlorophyll-a, turbidity, pH, electrical conductivity, dissolved oxygen content, BOD_5, COD, ammonium-nitrogen content, Nitrate, Nitrite, Orthophosphate, total phosphate content, total suspended solids and Fecal coliform) were measured on lake Nasser on basis of analyses carried out at nine measurement sites and the assessments were evaluated according to Egyptian Governmental Decree No. 92/2013 (GD 2013).
   - Fifteen water chemical parameters (Chlorophyll-a, turbidity, pH acidic, pH alkaline, electrical conductivity, dissolved oxygen content, BOD_5, COD, TOC, OS, ammonium-nitrogen content, nitrate-nitrogen content, Nitrite-nitrogen content, Orthophosphate and total phosphate content) has been determined in 15 sampling sites taken along Lake Balaton.
   - In this Dissertation, three Methodologies were developed to evaluate the physical chemistry parameters in water of Lake Nasser and Lake Balaton; (1) Assessment of the aquatic environment index (AEI), (2) TOPSIS and (3) SAW evaluation methods.
   - Using comparison method for Comparison of AEI results with TOPSIS and SAW evaluation methods by SRD (Sum of ranking differences).
   - SRD is a novel approach to compare the methods, it is an effective statistical tool to rank and numerically assess different solutions based on a reference, to avoid the differences between two MCDM ranking evaluation methods and using AEI assessment method as a reference factor.
2. **Biomonitoring study regarding heavy metal pollution has investigated by analysing water and fish samples in particular; liver, gills and muscles.**
3. **Heavy metal concentrations have been determining in water samples according to different standards** such as: Egyptian Governmental Decree No. 92/2013 (GD, 2013), environmental quality standards (EQS, 2008) (Directive 2008/105/EC) of European Union and by the guidelines for drinking water of USA (ESEPA, 2018), aquatic life suitability standard of Canada (CCME, 2007) as well as by Hungarian Governmental Decree No 10/2010. GD (2010).
4. **Heavy metal concentrations have determined at both lakes in two fish samples types;**
   - Nile Tilapia (Oreochromis niloticus) and
   - Bream (Abramis brama) according to several standards; European Community (EC, 2006), Food and Agriculture Organization (FAO, 2012), FAO/WHO limits (FAO/WHO, 2011), World Health Organization (WHO, 1989) and Ministry of Agriculture, Fisheries and Food of UK (MAFF, 2000).

5. **A comprehensive evaluation method was used to evaluate the correlation between the contamination with heavy metals and sample types (i.e., water, sediment, liver and muscles) of investigated items.**

The main evaluation indexes included the coefficient of determination (R2), and Pearson correlation coefficient (Corr).

6. **Metal pollution index (MPI) has been calculated** to investigate the ecological risk related to heavy metal contamination.

– The objective of this PhD research study aims to develop an easy, reliable and effective methods and protocols for water quality assessment and to devise a quantitative type of water quality assessment method which could provide rapid, accurate, and reliable information on quality of surface waters using water parameters. The first goal of this study aimed to determine the location of the least and most polluted sites around the lakes. To investigate the effects of heavy metals bioaccumulation in aquatic ecosystem, via water, sediments and fish organs.

The Dissertation is summarized by the following concepts:

– Model Development for water quality assessment, including: physical-chemical parameters and heavy metals contaminations as specific pollutants. Which has been applied in light of the international requirements defined by Water Framework Directive (hereafter WFD) and the huge world demand for pure and potable water supply. Investigating the water quality of Lake Nasser and Lake Balaton has been done by applying the aquatic environmental assessment (AEA) method according to Egyptian Governmental Decree No. 92/2013 (GD 2013) in Lake Nasser and Hungarian National Water Framework Directive according to the Decree No. "10/2010 (VIII.18.) of VM" (MSZ, 2010) in order to make recommendations for water quality improvement on the basis of conclusions of the study.

Physical-chemical parameters have been measured in water of lake Nasser and Lake Balaton by using three methodologies to evaluate the water quality:

a) Assessment of the aquatic environment index (AEI),
b) TOPSIS evaluation method and
c) SAW evaluation method.

Heavy metal concentrations have investigated in water samples according to different standards such as:

a) Egyptian Governmental Decree No. 92/2013 (GD, 2013),
b) environmental quality standards (EQS, 2008) (Directive 2008/105/EC) of European Union and by the
c) guidelines for drinking water of USA (ESEPA, 2018),
d) aquatic life suitability standard of Canada (CCME, 2007) as well as by
e) Hungarian Governmental Decree No 10/2010. GD (2010).

– In **biomonitoring** study regarding the heavy metal pollution using common **bream fish** type in Lake Balaton, and Nile Tilapia in Lake Nasser as indicator organisms.

– **Accumulation** rate of heavy metals in **Liver, gills** and **tissues** of **fish** has been investigated to understand the ecological risk related to heavy metal contamination.

– **Metal pollution index** (MPI) has been calculated which provides comprehensive information about the metal toxicity in a particular sample and offers an understanding of the quality of aquatic environment.

– This Dissertation combines the application of various assessment techniques which helps interpretation of complex data matrices to better understand water quality and ecological status of the studied systems.

– The Dissertation is designed, well distributed in **7 sections**: introduction, review of literature, and the aim of the PhD research work in the first part of it. Then, the materials and methods part followed by results and discussion, the conclusion and recommendations are presented and finally the scientific new findings.

– The structure of the Dissertation conforms to the principles and requests of the structure of the scientific work. The candidate has studied and used a suitable number of bibliography sources used and quoted in the Dissertation. It is evidence of the deep theoretical background knowledge and very good orientation to the problem discussed in the Dissertation.
The word processing of the Dissertation is adequate. The use of different heading is proper and helps the reader to better orientation in the text.

The Dissertation contains 101 pages

- First part: for the official and administration: 13
- The main (Scientific) body of the Dissertation: 88

The Dissertation consists of:

- 2 pages Abstract
- 21 Tables
- 37 Figures
- 2 pages Symbols and List of abbreviations and acronyms
- 1 page Acknowledgments

The Dissertation is divided into 7 sections

1) Introduction 4 pages
2) Review of literature 10 pages
3) Materials and methods 7 pages
4) Result and discussions 49 pages
5) Conclusion and Recommendations 2 pages
6) New scientific findings 2 pages
   the candidate summarizes the New scientific findings in 12 points the new findings achieved within the frame of the studies performed to solve the initially established goals.
7) Bibliography: 177 cited papers are presented in **11 pages** consist of 154 references with up to date (2000 – 2023), and 23 references before 2000

The topicality, aims, and methods of the Dissertation

– Generally, the described literature survey, methodology, and how results are presented are logically acceptable and relevant to the international standards and rules of good scientific practice. Aims and methods are clearly described; the candidate represents the ideas and knowledge with sufficient theoretical background. As a result, the aims were fulfilled; methods of research work are appropriate to the aims and hypothesis formulated in the thesis.

Results of the thesis and their benefit

– Given the purpose of this study, the candidate has performed good orientation and wide knowledge of water quality assessment, which is a very important tool to follow the variations in water quality of Lakes.
– Several techniques were used to evaluate the water quality and contribute to provision of high-quality water for Lake Nasser and Lake Balaton and to monitor water supply lines in Egypt and Hungary.

– The results illustrated that the northern part of Lake Nasser showed higher contamination compared with the southern part, however, the overall of water quality parameters were below the maximum distribution in water permissible levels of international standards and specifications.
– The concentrations of heavy metals in Lake Balaton were below the permissible limits values with relative elevation in western basin compared with the eastern basin. There is no significant difference has been reported between Tihany and Balatonfüred in case of Cd and Pb metals.
– Fish Muscles and liver were chosen as target organs for assessing heavy metals accumulation. The heavy metals load of fish muscles were performed to determine the potential human risk of consumption, whereas the concentrations in liver represent the storage of metals.
– In biomonitoring studies regarding the heavy metal pollution of Lakes using two types of fish as bioindicator organisms, significant positive correlations could generally be observed between the level of heavy metals accumulated in the organs and the pollutant load of the water.
– The highest MPI value has been reported in fish liver samples and sediments, while the lower MPI value were in fish Muscles.
– The dissertation is well structured and particularly the quality of figures is impressive.

The conclusion and the recommendations
– Based on the outcome of the study, it can be stated that the AEA can be expediently used for the evaluation of the water quality changes and provides a collective bioindicator for mapping areas where the water quality is poor. In addition, AEA supports the prioritization of future mitigation actions.
– In biomonitoring study regarding the heavy metal pollution using common bream as bioindicator organisms, and Lake Nasser using significant positive correlations could generally be observed between the level of heavy metals accumulated in the organs of common bream (*Abramis brama L.*) and the pollutant load of the water. MPI provides comprehensive information about the metal toxicity in a particular sample and offers an understanding of the quality of aquatic environment
– Heavy metal analyses in water and the edible parts of the fish indicated that water quality is good and fish are safe for human consumption. Heavy metal concentrations in fish muscles and livers meet the specifications stipulated by the international limits.
– The overall water quality of Lake Nasser is below maximum distribution in water permissible levels of international standards and specifications. Therefore, it can be concluded that water of Lake Nasser is safe for human consumption, agricultural activities and animal husbandry. Maintaining the water quality of the lake within these acceptable values represents an important mission for the sustainable development in Egypt, therefore all necessary actions must be implemented for protection of Lake Nasser.
– It can be stated that the parameters under investigation in different regions of Lake Nasser and Lake Balaton fall within the permissible ranges and the water of the lakes have good quality according to Egyptian and Hungarian standards; however, according to European specifications, there are steps to be accomplished for future water quality improvement.

Is the candidate's contribution to the research and publication(s) sufficiently large to award him a PhD?
– The Dissertation is an independent and comprehensive piece of work of a high academic standard. The Dissertation contributes to new knowledge of the discipline. The candidate's contribution to joint publication can be identified, and the candidate is solely responsible for a sufficient part of the Dissertation. The publication list of the candidate indicates that she is understand the problem of her research wok and had demonstrated how and by which method can be solved.

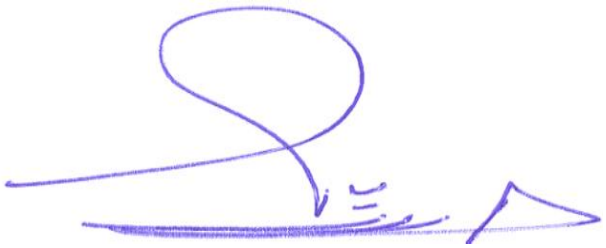
– The candidate has 7 articles in foreign journals as well as one in Hungarian journal.
– The candidate has 3 out of 7 published articles as first author, these 3 articles are very closed to the dissertation. and she acts as co-author in the rest of the list given all of them had high impact factor, which showed the significant of these publication to solve one the environmental problems.
–The candidate achieved in her last five years of publications with total **IF=25.118**.
– The candidate has attended 10 International Conferences as first author and She presented her results un oral presentations and in the form of abstracts. In the other 10 International Conferences she was as co-author.
The candidate presented her scientific achievements related to the present dissertation in a high number of international and national conferences, which demonstrates her high-quality scientific activity.

Questions
After reviewing few scientific comments:

1. Do you think that the climatic changes can cause changes in the water quality of the lakes through the changes in the values of the different parameters you measured, and why?
2. Given that Lake Nasser is an artificial lake. What are the consequences resulting from the construction of High Dam and Lake founding? And what is its importance to Egypt?
3. How did you measure the very low concentrations of heavy metals? Is it detectable on Atomic Absorption Spectroscopy?
4. Why you choose in your study Lake Nasser in Egypt in Lake Balaton in Hungary?
5. TU, NTU qualified as bad if high. What does turbidity depend on?

Conclusion
– Generally, the Dissertation is **scientifically accepted** for the **final open defence** and successfully defended. Finally, the PhD Dissertation **reached the scientific level of the degree** required.
– ADVANCED COMPREHENSIVE WATER QUALITY ASSESSMENT Dissertation submitted for obtaining a PhD degree from the Doctoral School of Chemical Engineering and Material Science at the University of Pannonia in the branch of Bio, Environmental and Chemical Engineering Sciences written by **Roquia Ibrahim Saad Rizk fulfils all the conditions for gaining a PhD degree in chemical engineering and material science; therefore, I recommend for approval**

Date: Budapest, 31st of march, 2023.



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