

Referee's Report on Doctoral Thesis

Title: EXTENDED METHODOLOGY FOR WATER RESOURCES AND WATER-RELATED ENERGY ASSESSMENT ADDRESSING WATER QUALITY

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1) Subject and Significance

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The submitted doctoral Thesis deals with the extended methods for water quantity-quality assessment and water-related energy consumption and emissions. There are no doubts about the increasing importance of water supply management, and the leading experts are convinced that water supply is becoming one of the crucial problems of human society in the future. To put water management on a firm scientific basis is a difficult problem because of the complexity of water fluxes that are influenced by many community, industrial, biological, meteorological, and political aspects. Therefore, to propose a useful and practical methodology covering all these influences and supporting management decision making is an interdisciplinary problem requiring broad knowledge. To conclude this paragraph, one can say that the topic studied is very challenging and up to date.

2) Scientific Content and the objectives

The objectives of his Thesis are formulated in the introductory Chapter I. From the results obtained, it follows that the aims of the Ph.D. The Thesis has been fulfilled.

The Thesis's novelty consists of the water availability footprint method to involve water quality impact into the existing water use assessment framework. Following the extended development of the water footprint assessment method, a cost-based Quantitative-Qualitative Water Footprint (QQWFP) considering multiple contaminants is proposed and illustrated with a case study of a Monosodium Glutamate (MSG) plant in China. The results indicate the significance of addressing water quality determination and the potential for water quality-oriented industrial water use optimization. The methods' significant novel contributions include 1) Evaluation of the impact of quantity and quality in water use in the form of cost. The water footprint comparison among different users covering multiple contaminants, 2) Applying the WSPA to a macro level elevates the ratio-based water scarcity assessment from a single determination to insight-based evaluation to guide the regional water resource management. 3) water quality cascade and water quality upgrade via mixing can improve the water use efficiency and reduce water scarcity.

This Thesis presents the extended methods for water quantity-quality assessment and water-related energy consumption and emissions. Three principal methodologies are proposed based on the Water Footprint concept and Water Pinch Analysis frameworks to assess water use's quantity and quality impact. These methods are also demonstrated with numerical and empirical

case studies targeting regional and industrial water resource assessment and optimization. Also, the Water-Energy Nexus is discussed to investigate water issues from a broader perspective. An initial evaluation of the water-related energy and GHG emissions of the seawater desalination industries is carried out. An initial assessment of the water-energy nexus in seawater desalination plants in China is also conducted in this Ph.D. study. The energy consumption, GHG emission, and the unit product cost of the seawater desalination plants in China are determined.

Impressive is the list of publications of accomplished tasks of the doctoral Thesis in national and mainly international scientific media and archive journals. The list comprises 8 publications with Impact Factor indexed in Web of Science, 9 publications with IF indexed in Scopus.

The work corresponds to the requirements of TU Brno and the Sustainable Process Integration Laboratory – SPIL. In its frame, the Thesis has been conducted on a doctoral thesis concerning the scientific aspects.

3) Substantial Aspects

Chapter 1 introduces the research scope of the Thesis, summarizes the research gaps, and presents the research aims and objectives. Chapter 2 presents a thorough literature review of water resources assessments, Water Footprint Assessment, Water Pinch Analysis, as well as the Water-Energy Nexus. The primary research work and achievements of the Thesis are introduced with three chapters (Chapter 3, 4, and 5). Chapter 3 introduces the extended water footprint assessment methods as well as the case studies. Chapter 4 introduces the Water Scarcity Pinch Analysis and implementations. Chapter 5 presents the initial determination of the national complete water-related energy consumption and its emissions in seawater desalination plants. Chapter 6 concludes the whole research work and outlooks the potentials for future investigation.

It seems to me that case studies are mostly done for China conditions. I lack the comparison with other countries and with the other method listed in Chapter 2. I also lack recommendations regarding the improvement of the present stage. I also lack the comparison of the industrial water supply by the single energy sources, including wastewater treatment and wastewater reuse.

4) Structure, Presentation, and Language

The structure of the Thesis is logical and follows the standards common to the field. There is an appropriate and complete presentation of the actual content. The author presents the results in a generally comprehensible form. A graphical interpretation of the work helps to follow easy scope and outcomes. This Thesis corresponds to a doctoral thesis's requirements in the technical sciences about linguistic correctness and stylistic expression. The author uses technical terms precisely. The work is presented extraordinary and with minimum errors.

5) Overall Assessment

Mr. Xuexiu JIA, MSc., is a hard-working Ph.D. student who has proven his ability to solve complicated and complex scientific problems. He has presented valuable results in both his Thesis and numerous related publications. I have no significant concerns about the scientific content, and I incline to recommend this Thesis to be accepted by the committee, and I do believe that after successful defense Mr. Xuexiu JIA, MSc., will be awarded the Ph.D. scientific degree.

Comments and remarks on the thesis for discussion:

1. Can you discuss in more detail the municipal water use structure?
2. Is the estimating of water consumption from water supply data the same as the amount actually used by the consumer?
3. What factors affect water use in a community water system?
4. What is your meaning about the double water quality (technical and drinking) utilization?
5. What portion of actually consumed water (domestic and industrial) goes into wastewater?
6. How are the wastewater reuse and reclamation respected in your considerations?

