10.06.2022, Freiberg

Give it a Benefit! - What do you Research for?
6th PhD Conference

- Abstracts -

TU BERGAKADEMIE FREIBERG

ProRat
PromovierendenRat
der TU Bergakademie Freiberg

List of oral presentations

Oral Presentations

Quarter solutions for energy transition using heat from mine water

Timm Wunderlich*, Lukas Oppelt, Thomas Grab, Tobias Fieback

TU Bergakademie Freiberg, Heat Technology and Thermodynamics, Chair of Technical Thermodynamics, Gustav-Zeuner-Str. 7, D-09599 Freiberg

contact: Timm.Wunderlich@ttd.tu-freiberg.de

Abstract

The usage of regenerative energies to heat up or cool down buildings is becoming even more important. Legislative authorities are paying more attention to supply residential buildings and districts with green energy from electrical and or thermal sources. The structural change in the housing market requires new and additional technologies in order to be able to leverage the further potential of the building offensive for a sustainable, renewable and independent supply as well as an updated construction exigency.

Flooded mines or groundwater pumping stations have a high heat potential all year round due to the usually large body of water. Those higher temperatures offer a constant potential for heating up and cooling down building through using heat pump technology. To judge the solution of using mine water you need to compared conventional heating and cooling applications such as heating oil or gas with their respective economic and ecological criteria. In addition, a comparison is drawn with regenerative supply sources such as bioenergy, which has comparatively low operating costs, or electrical energy. Fossil fuel energy has a higher overall operating cost and their also effect the CO2 balance of the area in a negative way. Additionally, there must be a comparison of the solution inquisition compared to other sources of renewable energy supply such as bio-energy which has a comparatively lower operating cost or electrical energy which has a higher availability. The possible usability of mine water or groundwater pumping stations is determined by their resulting annual performance indicator. This index number compares the influence of emission to the obtained usable energy to the admitted emission.

The annual operating costs of the system is based on the used electrical energy and on the annual performance indicator, which has the greatest potential of influencing the annual costs. With the help of constructed scenarios, there can be an evaluation on operational cost which are based on different scenarios which in cased are used to simulate different simulated to access possible future outcomes.

This study is particularly focusing on the lever of the annual performance factor on the price (that is influenced by the temperature difference between mine water temperature and flow temperature, length of the heat transport roadway, coverage of heating or cooling demand, et cetera) as well as the prices of the purchased electricity. The comparison includes the rising CO2 tax, the generation for own usage as well as the independence of the global energy market.

Biodismantling an ecofriendly way for the pretreatment of electronic waste recycling

Benjamin Monneron-Enaud*, Michael Schlömann

TU Bergakademie Freiberg, Institute of Biosciences, Leipziger Str. 29, 09599 Freiberg

contact: benjamin.monneron@ioez.tu-freiberg.de

Abstract

Electronic waste recycling is a major challenge of the recent development of electronic equipment. The increasing demand of metals to produce mobile phones, computers, etc. put a negative pressure on environment by pushing metal extraction from the environment. Ironically, at the same time, the recycling of the same metals is representing a low percentage of the production. This contradiction can be explained by the fact that the recycling of electronic waste is complex and technologies need to be further developed to make it a profitable business. One major problem of electronic waste recycling is the inherent complexity of the waste. These are assemblies of many different parts which result in a multi-layer material, including plastics, ceramics and different metals. Furthermore, once screens, batteries, and printed circuit boards are disassembled, these parts also contain different layers and components that can be dismantled. For this reason, conventional recycling of printed circuit board (PCB) fails to recover the totality of the metals that are present and is able to only recover the abundant metals like copper, or the valuable ones like gold and palladium. Common approach of PCB recycling starts with comminution process which dilutes component specific metals (CSM) which are located in different electronic components. Once homogenized CSMs such as rare earth elements are economically lost because of their too low grade in the mixture. Therefore, dismantling of the electronic components becomes a necessity to access these CSM. Actual dismantling technics are not very ecofriendly since the most used process relies on applying heat to melt the solder, which produces toxic gases and is energy expensive. This study introduces a new process to dismantle the electronic components from the PCB using biologically produced Fe^{3+}. The solder material that holds the components together can be dissolve using the biogenic solution resulting in the simultaneous recovery of the depopulated board, the fallen electronic components and precipitated solder metals.

Analysis of yeast extract components important for the bacterial activity and chloride tolerance of *Alicyclobacillus*

Katarzyna Kwiecień*, Lukas Richter, Stefan Kaschabek, Michael Schlömann

TU Bergakademie Freiberg, Institute of Biosciences, Chair of Environmental Microbiology, Freiberg, Germany

contact: katarzyna.kwiecien@doktorand.tu-freiberg.de

Abstract

The application of "green" technologies in the industry is steadily increasing. Environmentally friendly biotechnological processes are often similarly effective or even more effective than their conventional physicochemical analogues. This is also true for mining and metallurgy.

Bioleaching enables the release of metals such as copper from sulphur-containing ores and concentrates. While various studies have shown that chloride in the bioleaching environment can increase the efficiency of the process, especially for poorly leachable chalcopyrite, these ions are strongly inhibitory to most of the known bioleaching bacteria. Recently, however, we isolated a new acidophilic and moderately halophilic strain, *Alicyclobacillus* sp. S09, from a contaminated beach in Spain.

Alicyclobacillus and *Sulfobacillus* strains are usually cultivated in the presence of low concentrations of yeast extract. Studies have shown that yeast extract seems to have a positive impact on the chloride tolerance of *Sulfobacillus*. While yeast extract is expensive for technical application, in practice it may be replaced by organic carbon released from autotrophic bacteria. Yeast extract may serve multiple functions, as electron donor, as carbon source and as a source of vitamins, i.e. of compounds that the cells cannot produce themselves. In order to obtain more insight into the role that yeast extract plays, the effect of different amino acids, vitamins and organic compounds on *Alicyclobacillus* sp. S09 activity was tested. Oxygen consumption of bacteria was measured with PyroScience® Oxygen Sensor Spots for 8 days of the experiment.

The investigation revealed that the most important vitamins for *Alicyclobacillus* sp. S09 are thiamine and niacin. Moreover, glutathione had a strong effect on oxygen consumption – even when glucose was available as electron donor and carbon source. Glutathione as an antioxidant compound may allow to counteract possible negative effects of the salt environment.

We expect that the presented study will help to better understand the physiology of heterotrophic bioleaching bacteria and the interactions in bioleaching communities via organic compounds.

Correlation of digital twin and roller surface sensor results for AZ31 alloy TRC process

Szymon Kwiecień*, Lucas Hamm, Max Weiner, Matthias Schmidtchen, Madlen Ullmann, Welf-Guntram Drossel, Ulrich Prahl

TU Bergakademie Freiberg, Institute of Metal Forming, Bernhard-von-Cotta-Str. 4, Freiberg, Germany
contact: Szymon.Kwiecien@imf.tu-freiberg.de

Abstract

Due to the growing interest in lightweight construction in the automotive and aerospace industries, among others, continuous casting of non-ferrous metals is constantly expanding. This is due to the cost-effectiveness of the process, as it combines several steps in the production of metal sheets. Unfortunately, due to the nature of the process, the parameters in the rolling gap, such as for example pressure and temperature, are unknown, which significantly affects the ability to understand the phenomena occurring in the rolling gap and thus in the material during rolling. In this work, a possible solution for the transformation of a twin-roll casting process into a process that allows live control of the rolling parameters in the rolling gap by means of inline sensors will be presented. Therefore, at IMF Freiberg, a sensor was mounted in the surface of the TRC-roller, consisting of a piezoelectric sensor and two thermocouples measuring the temperature at two different heights, in the same measuring plane as the pressure sensor. This combination enabled the temperature of the roll and the pressure in the rolling gap to be monitored live during the Twin roll casting trial. The measurements were further supported using a digital twin in the form of a layer model, first proposed by Weiner in IMF. The model used in this work is an extension to the viscous part of the layered model proposed by Schmidtchen and Kawalla, based on the classical elementary theory of plasticity, which aimed to model the non-uniform deformation behaviour during flat rolling. This resulted in the author's model, which combines the liquid (as viscous) and solid (as elastic-plastic) regions for each layer in a single tool. Calculations in this tool are performed offline and the computational time is many times shorter than for the finite element method, as the calculations times are of the order of seconds. Experimental results have been obtained that allow a direct correlation between the shape of the pressure and temperature distributions and the length of the fully solidified LD part in the rolling gap zone, which directly correlates with the effective total equivalent stress. By using the sensor and layer model, it is possible to train a digital twin that can be used for on-line estimation of the final strip parameters obtained in the TRC process.

Keywords: twin roll casting, rolling, layer model, digital twin, sensor

RoBiMo- Robot-assisted inland water monitoring

Pose, S.*,[1]; Jarosch, L.[2]; Dreier, O.[3]; Röder, E.[4]; Grab, T.[1]; Fieback, T.[1]

[1] Scientific Diving Center of the TU Bergakademie Freiberg, Gustav-Zeuner-Str. 7, 09599 Freiberg, Germany
[2] Chair of Hydrogeology and Hydrochemistry of the TU Bergakademie Freiberg
[3] Institute for Electronics and Sensor Materials of the TU Bergakademie Freiberg
[4] Interdisciplinary Environmental Research Centre of the TU Bergakademie Freiberg

contact: sebastian.pose@ttd.tu-freiberg.de

Abstract

The goal of the RoBiMo project (https://tu-freiberg.de/robimo) is to develop a modular measuring system for holistic recording of the condition and processes in inland waters through a continuous and automated measurement. The system measures regular, continuous and spatially resolved parameters of water quality in standing inland waters. The different measurement systems, the multi beam echo sounder system, the water quality sensor chain and the respiration gas chamber can be installed on the variable load system. The navigation of the swimming robot takes place autonomously from a base station on the bank due to a network-independent connection.

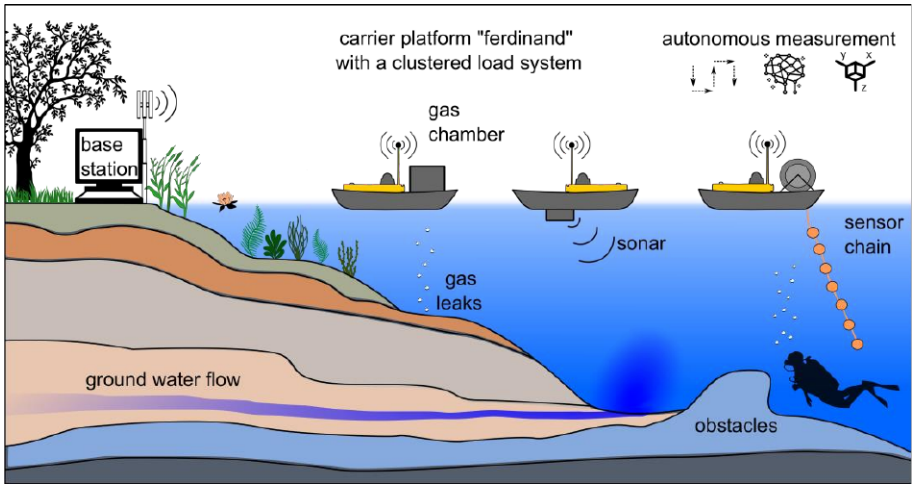

Figure 1: Plan and scheme of the investigation of inland waters by means of an autonomous swimming robot as part of the RoBiMo project.

A comparison of the measured "ground truth" values with water and sediment samples is realized by scientific divers. Furthermore, the scientific divers can manipulate the sensors to check the functionality in situ. In the event of problems with the sensor system or the robot, the divers are on site. The results of the water parameters are used to create the basis for automated water monitoring, to develop and test methods and approaches. Detailed images of selected underwater objects (cultural heritages, mechanical components, biological objects, etc.) are additionally recorded by scientific di-

vers using photogrammetry. In order to merge the data, it is essential to integrate them into a uniform data structure.

The results that can be derived by the swimming robot will be applied in the areas of hydrology, mechanical engineering, environmental technology as well as robotics and computer science. Seasonal and local changes in the water bodies/study sites can be documented.

Tribological investigations on the radial shaft seal under the influence of the countrary surfaces and different relative velocities

Lin, Y.*; Nepp, R.; Kröger, M.

Technische Universität Bergakademie Freiberg, Institute for Machine Elements, Engineering Design and Manufacturing, Freiberg, Germany

contact: Yongzhen.Lin@imkf.tu-freiberg.de

Abstract

This study asks after a methodologically representable relation between different contrary surfaces, relative velocities and the tribological behavior of the radial shaft seal (RWDR). The usage of a RWDR is usually as a dynamic seal element between the casing and the gear shaft. The appropriate application of RWDR in different types is depending on different boundary conditions. This work focuses on the influence of different contrary surfaces and relative velocities. It is recommended that the RWDR, the contrary surface (or shaft surface) and the operating condition should be matched in a tribological system. These considerations are limited on the one hand according to the DIN standard 3760, on the other hand depending on the application area of the seal element. The formation of the lubricating film between the shaft and the seal is significantly influenced by the contrary surface structure and the material of the shaft and thus the tightness of the seal element. The tribological behavior between the seal and the shaft is examined experimentally, particularly focusing on the contrary surface. A specifically established RWDR test station at the IMKF institute is available for the experimental investigations. Among other standard contrary surfaces, 3D printed components are used as a replacement. The aim of this work is to set up a basis for the future researches regarding optimization options for wear reduction and service life extension of the RDWR. As well as gaining new insights for the replacement of 3D printed contrary surfaces.

Asian World Heritage Fortifications - A Case Study of their Inscription by Criterion (ii); interchange of human value

Semina An

Institute of Industrial Archaeology and History of Science and Technology, TU Bergakademie Freiberg, Freiberg, Germany

contact: ssam2na@gmail.com

Abstract

It has not been long since the notion of World Heritage has introduced itself into our daily lives and research field. Since the adoption of the "Convention Concerning the Protection of the World Cultural and Natural Heritage" by UNESCO in 1972, cultural/natural sites that humanity needs to protect have been inscribed on the World Heritage List by assessing their Outstanding Universal Value (OUV). The criteria by which the OUV of cultural/natural heritages is evaluated, in particular criterion (ii), describes heritage as a result of "exchange" due to mutual relations between different cultures. The fact that it is a heritage created by the exchange and coexistence of multiple cultures throughout history evokes universal sympathy from the World Heritage perspective of preserving the common heritage of humanity.

This project intends to understand 'Interchange of Human Value' in UNESCO World Heritage that has not been studied before, using examples of Asian fortified heritages inscribed on the World Heritage List. Moreover, this thesis demonstrates the applicability of the Interchange of Human Value to the world fortified sites without criterion (ii).

Fortified heritage is an appropriate example to understand the value of criterion (ii) because it has emerged at the intersections of various exchange relationships, has influenced each other, and has experienced development and decline. The cases of fortified cultural heritage focus on the region in Asia that meet criterion (ii) and have been included in the list since 1996, when the definition of criterion (ii) was changed from "influence"to ëxchange of human values".

The aim of this dissertation is to provide an in-depth study of the Interchange of Human Value through case studies of world heritage fortifications in Asia and to show traces of historical exchange. This thesis will contribute as basic study on criterion (ii) for tentative World Heritage sites, but also for listed Heritage sites, to specifically assess the value of exchange.

References

1. Jokilehto, Jukka: The World Heritage List. What is OUV? Defining the Outstanding Universal Value of Cultural World Heritage Properties. 1st edition Berlin: hendrik Bäßler, 2008.

2. UNESCO World Heritage Centre: 'The Operational Guidelines for the Implementation of the World Heritage Convention', 1977 2019

Keywords: UNESCO World Heritage, the World Heritage Convention, Criterion (ii), Interchange of Human Value, World Fortified Heritage, world heritage study

Microbiological Arsenite oxidation at low pH

Cristian Jorquera Roman*, Michael Schlömann

TU Bergakademie Freiberg, Institute of Biosciences, Leipziger Str. 29, 09599 Freiberg, Germany

contact: Cristian-Felipe.Jorquera-Roman@ioez.tu-freiberg.de

Abstract

Due to the increase of the demand for valuable metals and to the lack of high-grade minerals, the leaching of arsenides and arsenosulfides has elicited more interest in recent years. The leaching of those minerals, means the release of the metals of interest and at the same time the release of arsenic as a byproduct. Arsenic is released from those minerals as arsenite (As(III)) which is more toxic and mobile than arsenate (As(V)). Therefore, oxidizing As(III) is of severe importance to reduce its toxicity and to be able to stabilize as a stable product. So far, the mining industry has been directed towards the use of chemical arsenic oxidation, at low pH conditions, which results in the use of expensive or scarce chemicals agents. Nonetheless, the use of microbiological As (III) oxidation at low pH hasn't been extensively understood. The use of microorganisms presents some advantages compared with the chemical process, by being cheaper, easier to scale up and more environmentally friendly. Thus, the objective of this work is to find new microbiological ways to oxidize As (III) and its application in the industry, offering a more green and cheaper option than the current one. For that, the focus of this research was to isolate new microorganism able to oxidize As (III), or the use of other bacterial strains with a novel scope, to unravel the arsenic oxidation mechanism behind and understand its appliance.