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THE UNIVERSITY OF QUEENSLAND AUSTRALIA

CREATE CHANGE

AVAILABLE TECHNOLOGY

High frequency/low voltage pulsed power for dewatering mineral tailings

Key features

- Methods and/or systems for dewatering mineral tailings that comprise a mineral component with water bound within
- Subjecting mineral tailings to a pulsed electric field to liberate the water bound within or to the mineral component of the mineral tailings
- Utilises high frequency and low voltage pulsed power to separate water from mineral tailings such as copper, coal, red mud and diamond slime

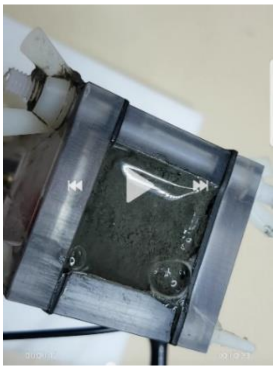
Background

During mineral processing an ore is comminuted and subjected to various chemical processes to extract valuable components. The declining of ore grades, mining of more complex ores, more intense grinding, and changes to processing technology, all have contributed to larger volumes of mineral processing tailings produced globally each year. The recent catastrophic failures of tailings storage facilities are a reminder that tailings slurries pose short and long-term economic, environmental and human health risks and as such, tailings management is a significant challenge for the mining industry.

Originally mineral tailings were disposed of directly into waterways such as rivers or the ocean. It is now common practice to store mineral tailings in dams, ponds, purpose-built above ground structures or by dry stacking the mineral tailings.

The use of tailing storage facilities still has significant shortcomings. Storage facilities of wet tailings require large areas of land that cannot be reclaimed prior to closure. Tailings dams contain high volumes of trapped water that contribute to the causes of failure. Extensive plant equipment and use of potentially toxic chemicals is needed for dewatering. The current dewatering technologies are energy intensive and cannot cope with large rates of mineral processing throughput.

There is a need to develop an alternative method for the dewatering of mineral tailings whether for storage in tailings dams or via dry stacking. There is also a need for in-situ recovery of water from deposited tailings in water stressed areas.



The technology

Researchers with The University of Queensland's (UQ) School of Information & Technology & Electrical Engineering (ITEE) and Sustainable Minerals Institute (SMI) have invented a method for dewatering mineral tailings. A pulsed electric field with a high frequency of from about 1kHz up to about 1 MHz and a peak electric field strength of from about 5 V/cm up to about 500 V/cm is used to liberate water bound within or to the mineral component of the mineral tailings. This is water that is attracted to, or is interacting with and/or adsorbed to, surfaces of the mineral components of the mineral tailings.

Mineral components can comprise of a tectosilicate mineral-quartz, a phyllosilicate material-serpentine, kaolinite and montmorillonite, a ferromagnesian mineral-olivine and a carbonate mineral-calcite. It can be comprised of one or more metal oxides, metal hydroxides, mixed metal oxides or mixed metal hydroxides. It can also be comprised of metal sulphides-pyrite, ferromagnesium minerals-chlorite, carbonates-dolomite, aluminosilicate minerals-feldspars and phyllosilicates-clay minerals.

The mineral tailings are subjected to a continuous pulsed electric field, which is typically comprised of locating the mineral tailings between two electrodes or plates (**Fig.1**). An electric current is passed through at least a portion of the mineral tailings. The electric current waveform and amplitude depend on the conductivity of the tailings.

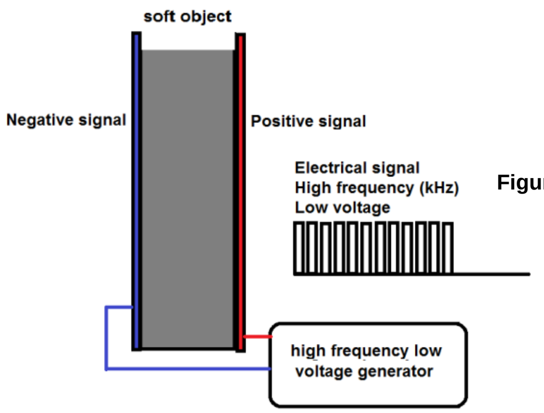


Figure 1.

Intellectual property

1. Dewatering Process: AU Provisional Patent #2019903955 21-10-19

   This invention relates to a method for dewatering mineral tailings comprising of a mineral component with water bound within or thereto.

Commercialisation opportunities

We are seeking licensing or collaborative partners to further develop this exciting technology for applications in mining and resources, pond and dam storage facilities and industrial applications.

Research leaders

Professor Firuz Zare is an academic staff member with the School of ITEE at The University of Queensland, Australia. He has published more than 300 peer review journal and conference papers, technical reports and 5 patents in the area of power electronics and pulsed power. He established a joint chapter of the IEEE Power Electronics/Industrial Electronics/Industry Applications Societies in Queensland in 2017. His research includes power electronics and control - control and conversion of electrical power from milliwatts to hundreds of megawatts using semiconductor power devices; renewable energy systems - power electronics for smart and future grids with single-phase and three-phase Active Front End (AFE) systems; EMI/EMC and Harmonics - pulse width modulation (PWM) to control magnitude and/or frequency of output voltage in power electronics converters; pulsed power- pulsed voltage with short duration and high amplitude for ozoning, sterilizing, recycling, medical an military systems; wide band gap devices - semiconductors, such as silicon carbide (SiC), gallium nitride (GaN).

Dr Negareh Ghasemi is a lecturer with the School of ITEE at The University of Queensland, Australia. Her research interests include power electronics and control, pulsed power and ultrasound systems and their applications. Power electronics systems consist of switching electronic circuits to control and convert the electric power. Pulsed power technology refers to the very short high-power electrical pulses, which can be applied in many industrial and bioelectric applications such as water treatment, food processing and sterilization. Ultrasound systems are found to be effective technologies in several applications due to their ability in mechanical energy in electrical energy and vice versa.

Associate Professor Mansour Edraki is a senior researcher for the Sustainable Minerals Institute (SMI) at The University of Queensland, Australia. His research, extending more than two decades, has focused on developing innovative techniques for understanding and predicting geochemical processes which underpin sustainable management of mine waste and tailings. Specific areas of research include geochemical effects of clay minerals on deposition, dewatering and rehabilitation of tailings; formation and stability of secondary minerals and amorphous phases and their role in natural attenuation of metals (and metalloids) and remediation of mine tailings and associated seepage; and novel techniques for characterisation and prediction of AMD including development of kinetic leaching procedures.

About UniQuest

UniQuest is Australia's leading technology transfer company. We manage and commercialise the intellectual property of UQ to create change and deliver solutions for a better world.

Our innovation portfolio has seen the creation of more than 100 start-up companies, and includes Australia's first blockbuster vaccine Gardasil®, the internationally acclaimed Triple P-Positive Parenting Program and superconductor technology used in most of the world's MRI machines. In 2015, our spinout company Spinifex Pharmaceuticals secured Australia's largest ever biotechnology acquisition.

Contact

Derek Stephens
Director, Commercialisation - Physical Sciences
UniQuest Pty Limited

P: +61 455 834 333
E: d.stephens@uniquest.com.au