نقابة المهندسين الأردنيين
Jordan Engineers Association

مـؤتـمـر التعديــن الأردنــي الدولــي الثـــامن

The 8th Jordanian International Mining Conference

الثـروات الطبيـعيــة: آفــاق الإستثمــار بين الواقع والطموح

Natural Resources: Projected Investment, Reality and Aspirations

19-21 September

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Holiday Inn Hotel, Amman-Jordan

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RWE

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Natural Resources: Projected Investment, Reality and Aspirations

Dear All ..

On Behalf of the Organizing Committee , I would like to express great gratitude and appreciation to his Excellency Mr.Faisal Al Fayez, Senators Council chairman, for his patronage of the eightieth Jordanian International Mining Conference (JIMC 8), and I am pleased to welcome all participants , authors and guests to the conference, organized by the Mining , Geological and Petroleum Engineering Branch of Jordan Engineers Association under the slogan:

" Natural Resources: Projected Investment , Reality and Aspiration "

The Organizing Committee has chosen the conference themes that reflect the interdisciplinary nature of today's science and technology and emphasis the importance of mining and energy sector in addressing communal and economic problems . Controlled mining of nature resources with non-harmful sequences on environment is the goal of modern mining activities for better future of the mankind on earth . The five themes that cover the goals of this conference are : Oil ,Gas and Oil shale, Industrial Rocks and Minerals, Geotechnical Engineering, Water and Environment and Mining Strategies and Safety.

Thirty three papers and presentations have been carefully selected by Scientific Committee . These papers and presentations are coming from about 55 researchers and specialists from different countries in addition to Jordan . The conference will compromise eight sessions over three days . In addition to the paper presentation , three Keynote speakers were invited from USA , Morocco and Jordan to talk about: Understanding A Phosphate Ore and The Engineering Principles to be Applied, the role of the Arab Industrial Development and Mining Organization in supporting and developing the Arab mining sector, and Energy and natural resources in Jordan. Also, two panels will be organised to discuss the investment opportunities in this regard.

In concurrence with the conference, a specialized exhibition is held to give a chance for mining and energy companies to present their activates , latest technologies and products related to mining and earth sciences .

Special thanks and appreciation goes to all panelists , keynote speakers , authors and delegates for their participation , and I wish our distinguished guest a pleasant stay in Jordan and a safe return to their home countries .

I would like also to express my deep appreciation and thanks to my colleagues in the organizing committee for their hard work, continuous follow up, whom have made a lot of efforts to make this conference a reality . Sincere thanks and gratitude to members of the Conferences Division of JEA for their support and hard work and for all their people who also have worked hard and complete other activates.

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Eng. Omar Al Tahat

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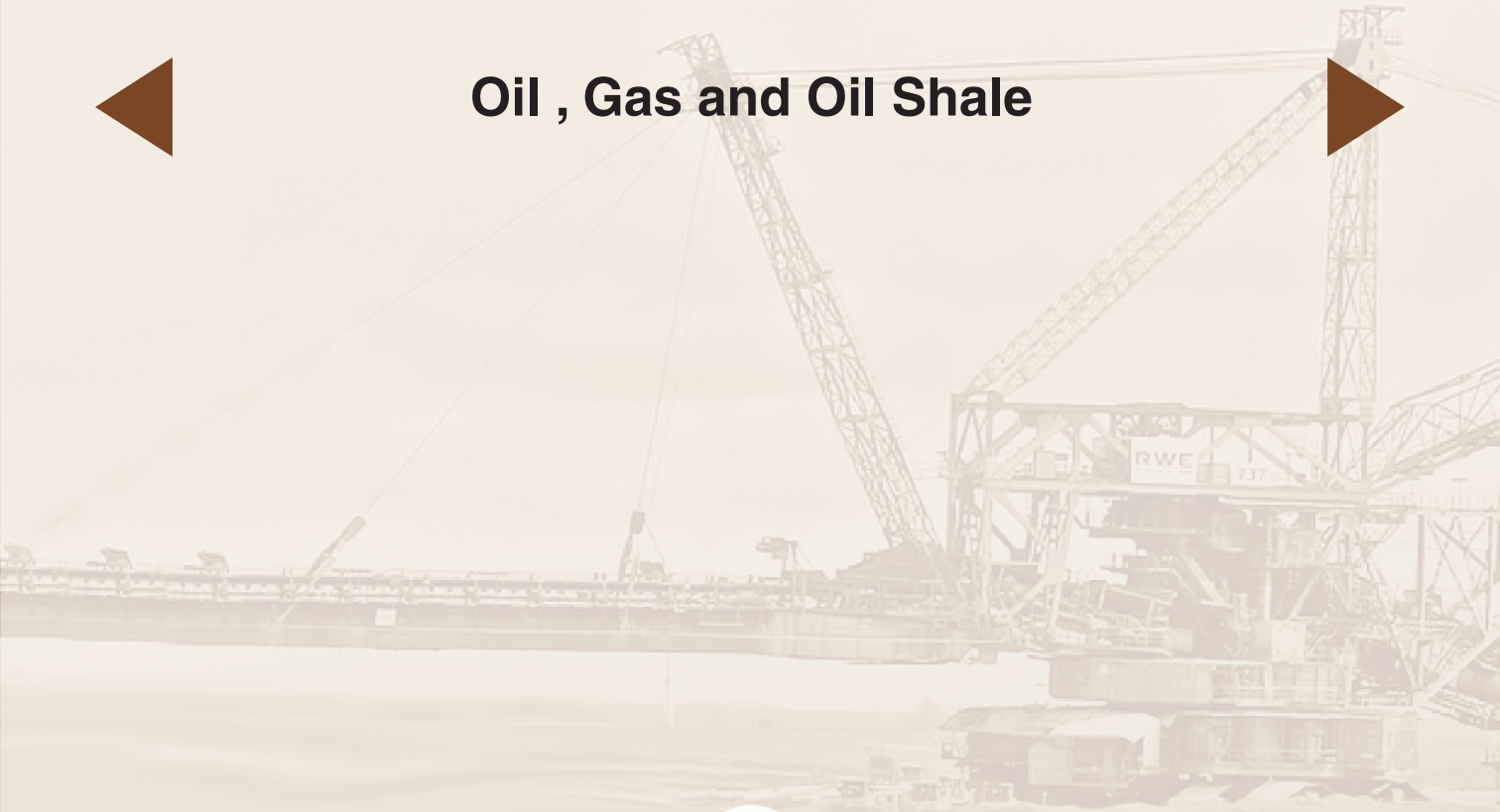
Content:

Oil , Gas and Oil Shale



Asphalt and Heavy Oil Recovery From Hamza and Wadi Rajil Area Located In The Azraq Region Using Thermal Oil Recovery Methods

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Abstract

Exploratory drilling for upper cretaceous (Cenomanian –Turonian) crude oils in the wadi Rajil- Hamza area of the Azraq depression in the north east of Hashemite Kingdom of Jordan has confirmed the presence of large quantities of residual hydrocarbons (Asphalt and heavy oils)within three zones ,with limestone ,dolomite and sandstone .The estimates area 296520 acres (1200 km2) could possibly contains 5 billion barrels of original hydrocarbon in place.

It should be noted here that the main purpose of this study has been the evaluation of the hydrocarbon potential of the Ghareb and upper Amman formations .A suitable recovery technique is proposal a pilot project for in –situ combustion underground and horizontal producer wells to increased the productivity , reduce the viscosity of the residual hydrocarbons , and , should prove to be an economically viable means of heavy oil and asphaltic extraction. The study of a pilot project of in-situ combustion to drill one vertical well for injection air in the top reservoir ,the other horizontal well for injection in the middle reservoir and the third horizontal producing well in the line of reservoir .

If the project proves to be profitable producing 124.43 bbl per day at least which means the recovery of capital expenditure in around 999.9days (2 .732 years) and the recovery efficiency proves to be high and by applicable the horizontal producer wells technology to increased the productivity . The project could be expanded in the Azraq region area .

The possible method is proposed for thermal recovery of this reservoir ,a dry Forward combustion and wet combustion underground project is preferred one or alternatively a combination of steam soaking and steam drive .

"Applying Performance Management System in Energy Companies: Enhance Performance and Provide competitive advantage for the Company and its Customers"

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Abstract

Developing and applying effective Performance Management Process will improve company performance, allow senior management to set business objectives, challenge the targets and monitor progress toward strategic goals.

This paper will outline the different phases of the performance management process, how to link the organization strategy to measureable targets and clarify priorities, roles, responsibilities and accountability.

The paper also, will discuss the structure of the performance management system and its deferent elements.

In addition, the role of performance management in supporting other processes, such as planning process, human resources and people development, management decision making process, ..etc. will be reviewed.

As case study, this paper will present the findings of a 3-years performance assessment of a oil company against a pre-set Key Performance Indicators (KPIs).

Finally, the paper will end up with conclusions/recommendations and way forward.

Stratigraphic and Hydrocarbon potential of the Paleozoic succession in Jordan

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Abstract

Jordan is part of the Arabian platform in general 46- km of sedimentary rocks over line the crystalline basement, however the sedimentary section is up to 10 km thick. The section comprises sediments ranging in age from late Proterozoic to Holocene. The Paleozoic rocks of Jordan crop out in the south western of the country. The sediments are situated conformably on the basement and dip gently to the west. In the eastern part of the country the sediments sub crop the Hercynian unconformity and are buried to depth of some 2000 m or more.

Northwards, the lower Paleozoic is unconformable overlain by Cretaceous clastic deposits, which in turn are seceded by Tertiary sediments and volcanic rock in the NE Jordan

The Early Paleozoic (Cambrian to Silurian) rocks are croping in southern Jordan. These sediments are entirely penetrated in two wells in Wadi Sirhan and Jafr areas (WS-3 and JF-1) and penetrated partially in more than 50 wells in Risha, Wadi Sirhan, Mudawwara, Azraq and northern highlands areas in Jordan. More than 3500 m of continental and shallow marine clastics with minor, but remarkable, carbonate section of Early-Middle Cambrian age (Burj formation) were encountered. In the Eastern parts of Jordan, the sequence recorded much more thickness, indicated by seismic.

In the outcrop area, the Cambrian section consists mainly of arkosic sandstones of the Salib and Umm Ghada formations. The Salib is situated directly on the Basement. The Burj formation, which consists of dolomites and shale, overlies the Salib and Umm Ghada formations and constitutes and important seismic marker in the area.

The Burj formation is overlain by the Umm Ishrin formation, which mostly consists of sandstone. These Cambrian formations have not been penetrated in the Risha area but the Burj seismic marker, which can be correlated over a vast area of the Middle East, is present.

The Disi and Umm Sahm formations consist of mainly braided fluvial to deltaic sandstones intercalated by minor shale beds of more marine origin. These formations are Ordovician age.

The Hiswa formation, which consists of shale and siltstone often bioturbated and with ripple

marks, attesting to its marine origin. The RH-3 well encountered the top of the Hiswa formation. Above the Hiswa formation is the Dubeidib formation. In outcrop it consists of a lower fine grained sandstone with skolithos burrows, a middle part with channel fill and intercalated sandstone with hummocky bedding and an upper sandstone similar to the lower sandstone. The total thickness is 125 m in outcrop. The three units were deposited in a shallow marine environment.

The area constituted a major depositional center during the early Paleozoic Hercynian uplift reactivated fault in Jordan and Strike-Slip faulting created isolated high such as the Risha platform. The Risha Platform area was characterized by non-depositional and erosion during most of the Mesozoic and Tertiary time.

In the Risha area the Dubeidib formation is much thicker and much more Shaly. There it consists of basal sand, a lower Shaly Silty unit, a middle unit with sandstone beds often showing coarsening upwards log profile and a upper Shale/Silty unit with few Sandstone intercalations. Due to its more Shaly nature, it was probably deposited in a slightly deeper marine.

The Late Paleozoic (Devonian to Permian) rocks are cropping out in Northern and Northeastern Saudi Arabia. These sediments were penetrated entirely in Jordan, whereas, sediments from Devonian to Permian age were reported. In Jordan, sediments from Carboniferous and Permian ages were reported environment compared to the outcrops.

الصخر الزيتي يتربع على مصادر الطاقة التقليدية

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الملخص

الكتلة البيولوجية ذات المنشأ النباتي والحيواني تأثرت بالمعادن ذات البيئة الرسوبية، بوجود عوامل فيزيائية أهمها الضغط والحرارة بالاضافة الى الزمن تم تشكل الكيروجين (مولد الزيت)، الذي يمثل العامل المشترك بين مصادر الطاقة التقليدية (فحم، بترول، غاز) وبين الصخر الزيتي، التغيرات الكيميائية والفيزيائية التي طرأت على الكيروجين أنتجت مصادر الطاقة التقليدية، طبيعة الصخور الرسوبية الحطامية والكربوناتية هي التي تحدد كمية المادة العضوية المحمولة وامكانية حركتها أو بقائها محتجزة داخل مسامات الصخور.

كل مصادر الطاقة التقليدية عانت وما تزال تعاني من مشاكل معقدة أثناء عمليات استثمارها، هذه المشاكل كانت أحد أهم أسباب تغيرات أسعار تلك المصادر، عدم ايجاد حلول مناسبة لتلك المشاكل جعلنا ننتقل من مصدر الى آخر بالاضافة الى تدني سعر ذلك المصدر.

وهنا نشير الى أن جميع مصادر الطاقة تواجه مشاكل حقيقية، مثلا:

الفحم الحجري يحتوي على نسبة من المواد العضوية، الكبريت، النتروجين، الهالوجينات، المركبات الأوكسجينية بالاضافة الى ارتفاع نسبة الرماد.

البترول الخام يحتوي على الماء والغاز المصاحب، والمعادن الثقيلة بالاضافة الى العناصر الأكالة.

الغاز يرافقه عناصر ضارة بالاضافة الى صعوبة نقله وتخزينه.

الصخر الزيتي كان الأسوأ حظا بين تلك المصادرحيث أدت النتائج المحبطة في استثمار الصخر الزيتي لكل من عمليات (الحرق المباشر، التغويز، الاسالة، الطريقة المركبة، الطريقة المكانية، التقطير السطحي)، الى عدم وجود تقانة فاعلة في معالجة الصخر الزيتي وأعاد اخراج عملية الحرق المباشر من خلال عملية خلط الفحم الحجري مع الصخر الزيتي.

الصخر الزيتي أحد أهم مصادر الطاقة الجديدة، معالجته بتقانة التعدين الاستخلاصي تجعل منه مصدراً أساسياً لكل من (الغاز، الزيت، الماء، الوقود الصلب، متبقي الوقود الصلبالذي يمكن استخدامه في مجالات صناعية أساسية)، آلية التعامل مع هذه المنتجات أسهل وأرخص وأكثر أمناً وسلامة من التعامل مع مصادر الطاقة التقليدية

Oil & Gas Potential In Jordan

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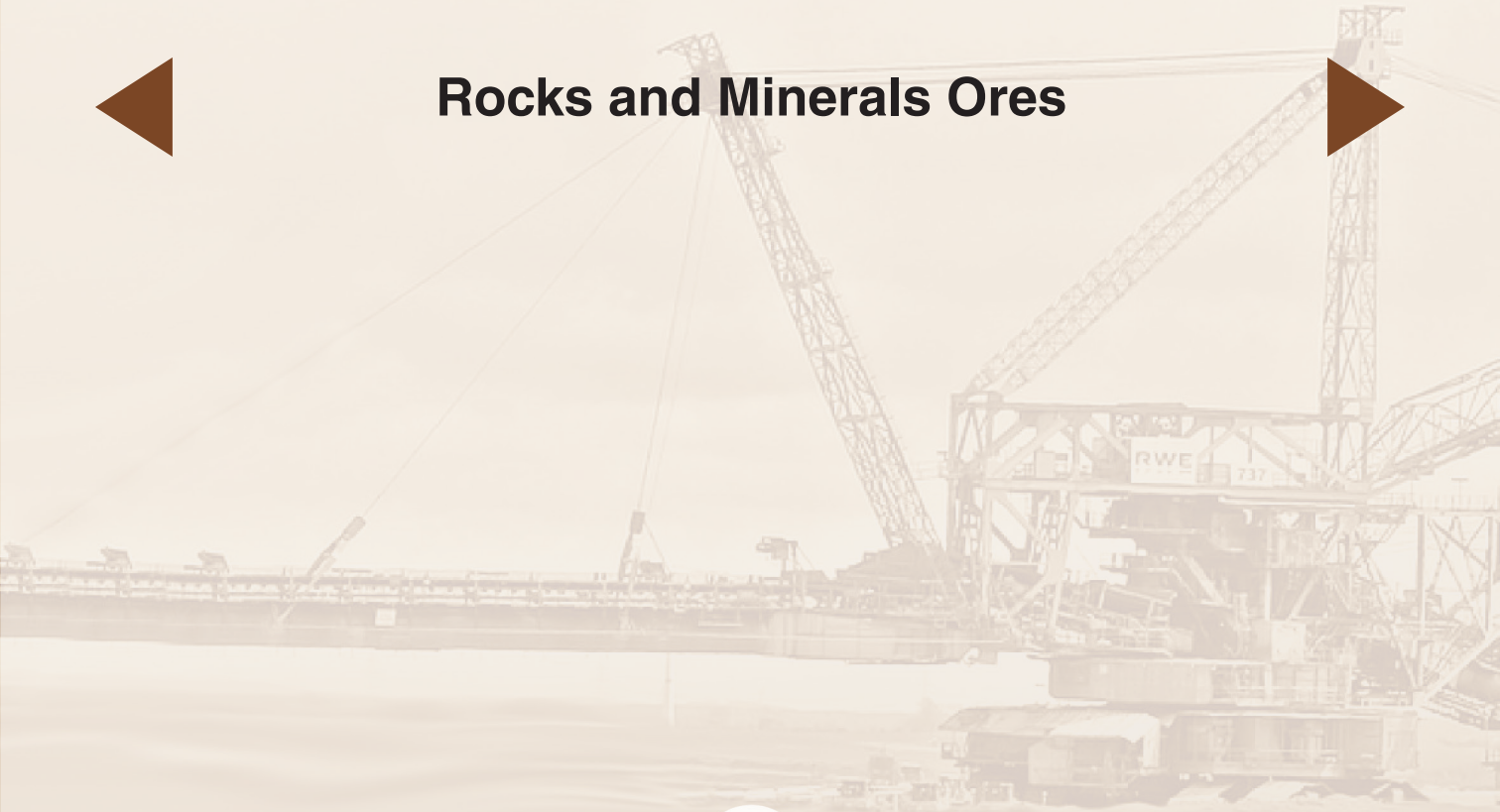
Abstract

Jordan is located within the producing sedimentary basin in the north – west Arabian plate .
Jordan has two basins with potential for shale gas and shale oil, the Risha area and Wadi Sirhan. Also Jordan has al Azraq basin which consists of several geological structures. About «1500» square kilometers of Azraq area were under study which prepared for NRA with a cost of about USD (2) millions evaluated the hydrocarbon potential in the area. The study indicated that an estimated of about (430) million barrels of oil have been generated from WS – 2 member which is the source rock in the Azraq area .
Two heavy oil wells have been drilled in the area, the data obtained from these wells indicates the presence of a vast amount of heavy oil and asphalt which could obtain crude oil by converting it by technical methods.
The Dead sea area is about (3750) square kilometers, many oil seeps are available in the area, most of the oil fields in the world have been explored and discovered through the seeps around it.
A core – hole drilling program in the area produced samples with an average organic carbon content (TOC) over 10%.
One of the wells which had been drilled in Wadi Sirhan area gave us the best quality of oil (sweet oil) with a gravity of (43o) API.
Other (5) blocks in Jordan that we can work on it for oil exploration are: East Safawi Block, West Safawi Block, North Jordan Block, Jafr- Central Jordan Block, and Wadi Sirhan Block.

Rocks and Minerals Ores



A new stratigraphic correlation for the upper Campanian phosphorites and associated rocks in Egypt and Jordan

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Abstract

Facies analyses and a sequence stratigraphical framework with regional correlation of the upper Campanian phosphate province are described and interpreted based upon three main sections located in Egypt (Gebel Duwi and Abu Tartur sections) and north Jordan (Umm Qais section).

Fifteen facies types were grouped into: phosphate (FT1–5), carbonate (FT6–11) and siliciclastic (FT12–15) facies associations. The main component of phosphate rocks are pellets in situ and common reworked biogenic debris especially in the upper phosphate beds (e.g., fish teeth and bones) with abundant Thalassinoides burrows suggests that the skeletal materials are the main source for phosphatized inputs in Egypt, while the common authigenically phosphatic grains (pristine) in Jordan reflects upwelling regime in oxic to suboxic zones.

Based on age assignment as well as stratigraphical position, the phosphorite beds show great similarity that may suggest the similar origin and adjacency during the period of deposition of the Duwi Formation in Red Sea coast of Egypt and its equivalent the Al-Hisa Phosphorite Formation in Jordan that represents the early transgressive system tract.

On the Abu Tartur Plateau, the presence of sandy pyritic phosphatic grainstone (FT1) and glauconitic quartz arenite (FT12) in the middle part of the studied section, along with the absence of the chert facies (FT14), reflects shallower marine depositional environment with increased fluvial sediment-supply than in those along the Red Sea coast and north Jordan.

Carnallite Froth Flotation Optimization and Flotation Cells Efficiency in the Arab Potash Company – Jordan

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Abstract

Arab Potash Company (APC) was formed to develop minerals from the Dead Sea which is the main and only source for the potash industry in the form of potassium chloride.

Dead Sea salts are converted into a final sailable product in the form of potassium chloride which is commercially known as Potash.

Currently, APC is producing potash for agriculture, chemical industry, industrial salt, bromine and NPK (Nitrogen, Phosphorus, and Potassium) fertilizers.

The flotation unit at APC is a significant part of the overall processes, which end up separating Halite from mixture, Halite separated as float, while Carnallite as sink.

The current study aims to provide a better understanding of flotation process. In this investigation, several laboratory experiments were conducted that covered main factors which affect significantly on flotation cell.

The best flotation cell efficiency in experiments was achieved in term of Halite removal and Carnallite recovery.

Tests were covered: Agitator speed, pulp density, reagent quantity, conditioning time, temperature effect, Ph effect, additives effect, size distribution effect, and wet screening analysis were performed.

The conclusion is based on analyses of the obtained results incorporated with direct observation from APC flotation cells.

Obtained results indicated that considering certain significant experimental parameters will reduce the loss and the overall cost, and, consequently, will increase the overall production

Peak Phosphate in Jordan: An analytical Study

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Abstract

The benefits and impacts of mineral resource extraction and processing in Jordan are changing and whilst our vast endowment of phosphate will not be exhausted soon, extraction and production are becoming more challenging. This paper establishes a conceptual analysis of 'Peak Phosphate' as a powerful tool and it uses Gompertz and logistic models for measuring the peak phosphate in Jordan. Our results showed that Jordan's phosphate is likely to peak in 2044 and 2048 according to Logistic and Gompertz models respectively. Phosphate production has already passed the peak year in Al-Hasa and Al-Abiad mines. The logistic model for Jordan phosphate which had a peak year of 2048 and a production value of 15.2 million tonnes matched exactly the Gompertz model for Al-Shidiyah mine with the same peak year and production value which confirms that Jordan's future phosphate production will totally depend on Al-Shidiyah mine.

Uranium resources and extraction: critical review

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Abstract

Uranium deposits are widespread throughout the sediments rocks in central part of Jordan. Uranium contents are not the same in each locality. The average thickness of the radioactive zone (Host Rock) ranges between 0.55-m. Uranium distribution is inhomogeneous and follows porous weakness zones of chalk marl/travertine and caliche/top soil deposits. The source of uranium and other redox sensitive metals Cr, Ni, V, Zn, and Zr is the combusted bituminous marl (varicolored marble).

The increase demand for reducing production costs, depletion of high grade deposits, and fulfillment of strict environmental constrains lead to the development of new technologies to extract uranium(U_3O_8) from its conventional and unconventional resources.Technologies have been developed to concentrate low grade surficial deposits with carbonates and clay gangue, uranium in sandstone ores, uranium associated with carbonaceous shale, and uranium in saline leach solutions and phosphoric acid .

In this work, a critical review of these technologies over the world will be presented by comparing their advantages and limitations, aiming at choosing the best technology suitable for Jordanian uranium deposits.

الإستثمار في خامات البنتونايت الأردني ومعالجته وتركيزه

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الملخص

الأردن غني بالصخور والمعادن الصناعية التي تعتبر الأساس في الصناعات التحويلية والإستخراجية التي توفر ما قيمته 70% من صادراتنا الوطنية، وهناك العديد من الخامات التي لم يتم إستغلالها ومازالت قيد الدراسات فقط، ومن هذه الخامات خام البنتونايت.

البنتونايت هو اسم يطلق على نوع مميز من خام الصلصال، ويعتبر صلصال طري دقيق الحبيبات يتخذ مظهر نسيجي ومن ظواهرة المميزة أن الرطوبة تجعل سطحه رغوي زلق، وعندما يجف يتشقق ويتكسر. ويعتبر البنتونايت ناتج عمليات تجوية الصخور والرماد البركاني، وهو أحد الصخور الصناعية التي تدخل في صناعات متعددة، وهو من الخامات المتواجدة بكميات وفيرة في الأردن خاصة في مناطق عين البيضا، قاع الأزرق ومنطقة اليمانية في العقبة، ويبلغ أعلى إحتياطي من هذه المناطق في منطقة عين البيضا.

مادة البنتونايت هي مادة يتم استخدامها لسند جوانب الحفر وخاصة في اعمال حفرآبار البترول والمياه ولكن يجب ضخ البنتونيت بشكل مستمر ومنتظم لضمان سند جوانب الحفر والا سيحدث مايسمي بظاهرة عنق الزجاجة نتيجة لعدم الضخ المستمر والمنتظم لمادة البنتونايت اثناء الحفر. وهي مادة تأتي على شكل بودرة بأكياس معبأة (50كغ) متوفرة من عدة مصانع أكثرها انتشارا متواجد في الهند بالنسبة للسوق الخليجي . وظيفتها الأساسية تعمل هذه المادة بعد خلطها بالماء على تدعيم جوانب الحفر للأوتاد, وذلك من خلال ضخها أثناء عملية الحفر في مكان الوتد ويُجدر الإشارة هنا أن نسبة كثافة هذه المادة تعتمد على نوع طبقات التربة فإن كانت التربة ضعيفة نزيد من الكثافة وإن كانت متماسكة نوعا ما نقلل من كثافة هذه المادة.

الصلصال

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الملخص

يمكن تعريف الصلصال (المواد الطينية) بأنه خام يتواجد في الطبيعة بمظهر ترابي قابل لامتصاص الماء وإنتاج عجينه دبقه ولدنه القوام قابله للتشكيل تستعيد تماسكها وصلابتها إذا جفت في الهواء أما إذا حرقت (شويت) فإنها تعطي ماده متماسكة متحجرة لا تتداعى إذا ما عوملت بالماء

من حيث المنشأ فان المادة الأصل لجميع الرواسب الصلصالية هي الصخور القوية الغنية بالالومينا حيث تتفكك هذه الصخور كيميائيا بفعل العوامل الجوية المختلفة أو بفعل التحول البسيط معطيه معادن طينية ونواتج أخرى

تطبيقات الإنتاج الأنظف في صناعة الأسمنت

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الملخص

تستعرض الورقة مقدمة عن القطاع الصناعي الاردني وبعض المؤشرات الاحصائية ثم تستعرض واقع صناعة الاسمنت في الاردن .

توضح الورقة انواع التلوث البيئي والصحي الناتج عن صناعة الأسمنت :

تلوث الهواء , النفايات السائلة , المخلفات الصلبة و الضوضاء والاجهاد الحراري

ثم شرح موجز حول مفهوم الإنتاج الأنظف وفوائده وآلية تطبيقة في المصانع, تم تشرح الورقة إجراءات الحد من التلوث في صناعة الاسمنت من خلال توضيح إجراءات الحد من تلوث الهواء و إجراءات الحد من تلوث المياه و إجراءات الحد من التلوث بالمخلفات الصلبة وطرق المحافظة على الطاقة (ترشيد استهلاك الطاقة) وذلك بالاستناد الى مؤشرات عالمية وتجارب عربية في هذا المجال.

ثم تستعرض الورقة مبادئ السلامة والصحة المهنية حيث ان هناك أربعة اسس للسلامة المهنية هي : الادارة، التدريب، بيئة العمل واشراك العاملين , وتوضيح الأهداف العامة للسلامة المهنية

واخيرا توضح الورقة المتطلبات البيئية المطلوبة لترخيص المنشآت الصناعية وتشمل الضوابط والاعتبارات البيئية لترخيص مصانع الاسمنت.

دراسة جيوتقنية على خامات حجر الترافرتين في منطقة الفيصلية/ محافظة مأدبا

م. نبيل صالح عديلات

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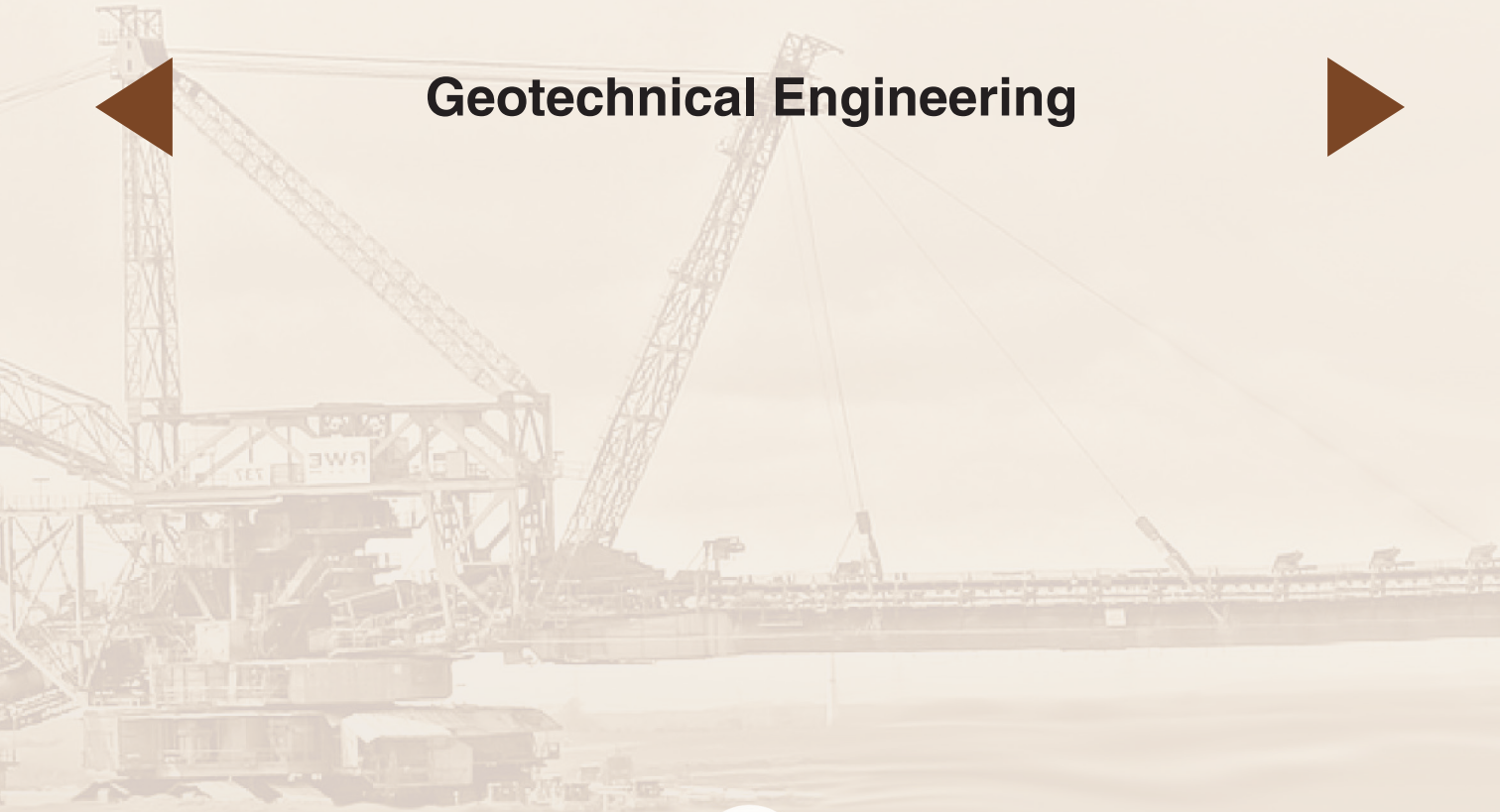
الملخص

يعرف الترافرتين بأنه صخر رسوبي كيميائي المنشأ، يتكون في الغالب من كربونات الكالسيوم، ويترسب الترافرتين نتيجة فقدان غاز ثاني أكسيد الكربون من المياه الساخنة أو الباردة نتيجة لانخفاض الضغط والحرارة المفاجئ بالإضافة إلى بعض العوامل الأخرى المساعدة في عملية الترسيب.

تعتبر رواسب الترافرتين من المياه الساخنة هي الأوسع انتشارا، وتتميز بدرجة مسامية عالية، كما يعتبر الكالسايت المكون الأساسي لها أما المكونات الأخرى فتشمل: الكوارتز، واكاسيد الحديد، والمنغنيز، والبازلت، بالإضافة إلى المعادن الطينية.

يستخدم الترافرتين في أعمال الديكور وكسوة جدران الأبنية من الداخل والخارج وأعمال الأرضيات المكشوفة والغير مكشوفة وكذلك في بعض الأعمال الإنشائية الأخرى.

Geotechnical Engineering



Advanced Technologies in digital 3D-Surface, -Deposit und -Mine-Modelling

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Abstract

Nowadays digital data management in the mining industry becomes more and more important to optimize the modelling, planning and operation process. New developments, increasingly efficient hardware combined with professional database- and web-technology open new opportunities in several mining segments. The lecture will give some practical examples from surveying, deposit and mine modelling to show advanced technologies in the aggregate and oil shale industry

Review of 50 years geotechnical studies at Amman-Jarash Highway landslides in Jordan

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Abstract

Landslides in Jordan caused many problems during the last 50 years which causes the loss of millions of Jordanian Dinars in addition to the waist of efforts and times for the government. The review of Amman-Jarash Highway landslides defined the main causes of landslides and rock mass movement. Previous works of geotechnical studies are summarized, and stability measures are discussed and analyzed to establish solution and recommendations.

The present study aims to convert the dangerous areas to green areas and the needs for annual maintenance to the drainage system along the highway before the winter season. In addition to concrete injection in unstable areas along the highway and construct emergency road to the east parallel to the highway particularly from Zarqa river bridge to the bridge of Jerash entrance due to presence of geodynamic activity which leads to landslides. Moreover, construct gabions in weak and unstable area along the high way to protect the area from mass rock movements and rock fall. Finally, annually evaluation highly is needed to the highway by competent and experience geological engineers as they are specialists.

A comprehensive overview about the reality of investment in the mining sector of Aggregates in Jordan

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Abstract

It is impossible to construct a city without using natural aggregate sand, gravel and crushed stone. The amount of these essential construction materials we use each year is likely to surprise you.

Annual production of aggregate worldwide totals about 16.5 billion tons (15 billion metric tons). This staggering volume valued at more than $70 billion makes aggregate production one of the most important mining industries in the world. In view of the urban and infrastructure development and the package of tax exemptions on the property during the past years as well as banking facilities and political reasons experienced by the region, which led to the influx of a large number of displaced people to this hospitable country, which increases demand for residential buildings in particular and the accompanying Which leads to an increase in the demand for the production of aggregates as the volume of investment in the housing sector increased.

Although potential sources of sand, gravel, and crushed stone are widespread and large, land-use choices, economic considerations, and environmental concerns may limit their availability. Making aggregate resources available for our country's increasing needs will be an ongoing challenge. Understanding how aggregates are produced and how the related environmental impacts are prevented or mitigated can help citizens, communities, and our nation meet this challenge.

Given the right information and access to suitable resources in appropriate geologic settings, aggregate producers can meet the nations demand for aggregate without causing undue harm to the environment.

التصدعات والتشققات في قلعة الكرك

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م.أسماء شخلتوغ / دائرة الآثار العامة

الملخص

نظرا لظهور التشققات والعديد من المشاكل في مواقع مختلفة من قلعة الكرك وخصوصا في الجدار الغربي حيث يوجود هنلك عدد من الصدوع والفوالق الماره في مدينه الكرك وتحديدا اسفل القلعة.

يمر اسفل القلعة فالق رئيسي يدعى (الفيحاء) بالاضافه لعدد اخرمن الفوالق القديمه والتي تؤثر و تترك اثارسلبيه لها في المنطقه على مر السنين والعصور ولكن يبقى هذا التأثير محدود تقريبا ويرجع ذلك عبر مئات وآلاف السنين.

ولكن ما حدث في السنوات الاخيره من ازدياد نسبة الشقوق و التصدعات في اماكن مختلفة من القلعة ادى الى اغلاق تلك المنطقة (الجهة الشمالية الغربية و تشمل القاعة الناصرية و المسرح و المتحف).

وحسب الدراسات المختلفة التي قمنا باجرائها (جيولوجية , جيوفيزيائية , جيواثرية , انزلاق التربة و الجيوتقنية) حيث اظهرت ان هناك عوامل واسباب اخرى غير تلك الطبيعية (الفوالق والصدوع و انزلاقات التربة) التي تحدث عنها الخبراء و المختصين.

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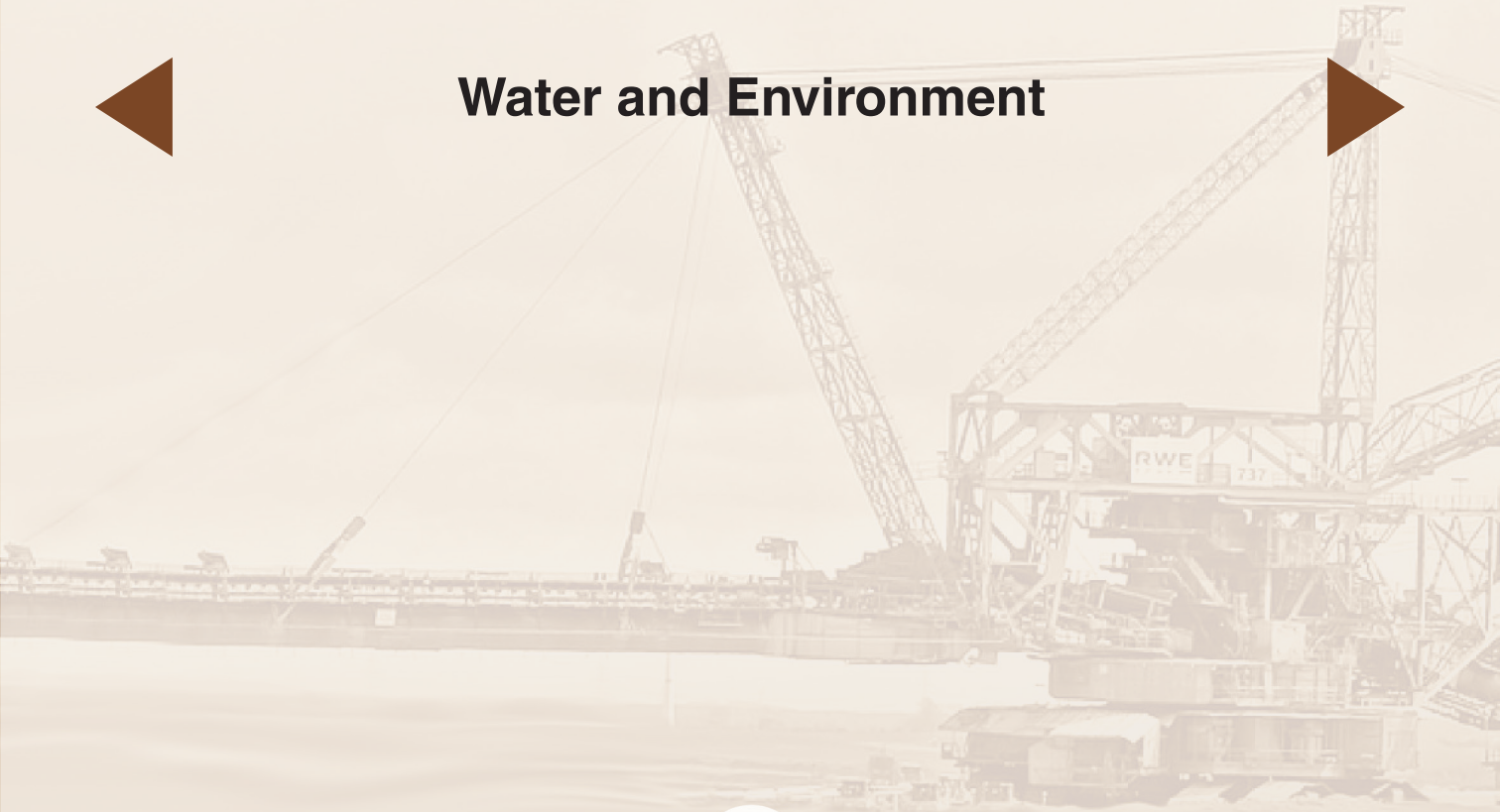
Water and Environment



Integrated Water Resources Management & Environment in Jordan

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Abstract

Jordan is classified among the countries of very limited water resources with shallow and fragile eco systems. Jordan shares some of its most important water resources with its neighboring countries. These resources from a large percentage of the presently exploited water resources, which the country depends on for meeting present and future water demand.

One of the most important shared water resources is the Jordan River system. Other important shared water resources include the groundwater resources of north Jordan (Disi, Azraq, Yarmouk and Amman Zarqa basins), where a large percentage of the natural recharge occurs in the Syrian territories.

Water resources in Jordan consist of surface and ground water resources as conventional water resource and treated wastewater used in irrigation as a non conventional water resource. Renewable water resources are estimated at about 938 MCM per annum, 276 MCM per year ground water and 662 MCM per year surface water. An additional 143 MCM per year is expected to be available from fossil aquifers and 50 MCM from brackish aquifers after desalination. Available treated wastewater for irrigation is about 155 MCM per year. Water sector suffering mainly from un accounted of water which keep on a level of 50% , more over water resources suffers of evaporation tension which come to 2600 mm/year from the free surfaces with fluctuation and limitation to the precipitations.

Due to the up normal population growth resulting from Syrian refugees and Arab spring (about 2.5 M) with extra 1.5 M staying for different purposes (study, work..etc,), the total population is about 11 M, the available renewable water resources per capita share are falling from around 170 m3/cap/year at past to < 90 m3/cap/year this year 2017. current use is already exceeding the renewable supply. The deficit is made up by overdrawing highland aquifers, resulting in lowering water table and declining water quality. The agricultural sector is the most affected sector in the country it's consume about 78.2% from the ground water, 2519 official well around the country pumping about 280 MCM/ year, more over 735 infracted well were damage by MWI teamwork's within the last few years, unless new resources are made available. The scarcity of water will affect the socio economic and well-being of the people.

Integerated Management For Water Resources And Enviroment Both Local & Regional Case Study: "Reprocess Agriculture Run Off Water (Subsurface Drainage Water) For Potash Production

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Abstract

Water is a major and essential element in potash production. To produce one ton of potash a five cubic meters of water is required. Potash factories consume about 12 million m3/year. Process water is used mainly for decomposition of carnallite, dissolution of sodium chloride in crystallization unit, washing of the sylvinite cake, cooling of pump seal and general purposes such as cleaning. This high consumption uses up mainly the good quality water on the account of farming and local community domestics' uses.

Since Water is also limited source in the area, a special attention has been given by The Arab Potash Company for water securing, even though the company has its own resources there is a gap between the water needs and the current available water resources, this gap is expected to be increased with the future potash planed expansion in addition to expansion in the farming fields in the surrounding area.

The principal goal of the Arab Potash Company has been to attain the best performance consistent with environmental compatibility at APC sites in both Safi and Aqaba and reduce environmental impact as far as possible in accordance with highest international standards. To bridge this gap, decrease good quality water consumption and protect the surrounding area from pollution (this water are not suitable for domestic or agriculture reuse), the agricultural run-off water are targeted resources for potash production.

This paper will highlight further details on reuse of agriculture runoff water in potash industry at the Arab Potash Company particularly quantity, quality and suitability of this water for Potash Production and project implementation works including the engineering design stage

The Characterization of Jordanian Porcelanite Rock in Water Treatment

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Abstract

The adsorption of Pb ions and 3,5-Dimethyl phenol from aqueous solution by Jordanian porcelanite rock has been investigated as a function of initial concentration, adsorbent dose and contact time at constant temperature and pH of solution. The equilibrium process was described by Langmuir and Freundlich isotherm model with maximum sorption capacity equal to 19.562 mg g-1, removal efficiency of 95 – 98% at about 40 minute of contact time, with 0.5 g of porcelanite and 10 – 30 ppm concentrations in metallic solutions, which is simulated by applied on car washing station wastewater. And get removal efficiency equal to 99.71% at about 1 hour of contact time, with 20 g of porcelanite and about 50 ppm concentrations of 3,5-Dimethyl phenol in organic solutions which was indicated by Total Organic Carbon and Ultra Violet/Visible absorption spectroscopy technique. The physical and chemical characterization, i.e. X-Ray Fluorescence, X-Ray Diffraction, Scanning Electron Microscope, Thermogravimetry analysis and Specific Surface Area have also been investigated for the Jordanian porcelanite rock which represents an alternative natural adsorbent. Porcelanite is a low cost material could be used for the removal of toxic inorganic and organic materials, in addition to its ability to be used as a filter.

The Red Sea - Dead Sea Channel Project Influence upon the Dead Sea Water Balance Equation

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Abstract

At present time, water balance of the Dead Sea indicates an annual shortage reaches about one billion cubic meters of water due to high evaporation rates, industrial abstractions and lack of coming inflow. This deficit in the water balance of the Dead Sea caused a critical decline in its water level as time went by. The drop of the water surface level increased dramatically, and the estimations include different figures of annual decline range from 0.79 m per year as a long term average calculated by the authors, and 1 m per year according to Arab Potash Company (APC) records in the last decade. There were many different proposals to come over this problem, the most accepted and agreed was the construction of the Red Sea – Dead Sea conveyance channel (RDSC). Therefore, the water balance equation of the Dead Sea should include a new component expressing the inflow of the Red Sea water. Then the changes of the water column height and the related volume of water in the Dead Sea Basin (DSB) will be calculated for successive years until reaching the preferred water level of (-395m), the calculations will use the annual increment of the RDSC inflows as a positive component, where the annual shortage will be subtracted from it. The calculations will include the annual loss rate of water, the impoundment per unit time and the total impoundment end value. The calculations where conducted through two different mathematical methods, the first is the direct numerical summation method and the second is the compound numerical equations. The compound equations solving for the loss rate, the annual impoundment and the end impoundment value can be utilized to build up a mathematical model to simulate for different unknown parameters in related equation.

The Role of Nuclear Techniques in Water Resources Investigation, Protection and Management in the MENA Region

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Abstract

The Middle East and North African countries are characterized of an arid environment, Also In the Arab region, because of already high level of water stress especially for drinking water supply and food imports. This paper emphasize the role and importance of nuclear methods and technique of peaceful application in water resources studies, water supply, water and environment protection. It outlines future requirements and aspects of using nuclear techniques in various water issues toward better utilization and management of water resources, also highlights some examples and pilot areas of shared water from the MENA region and Arab countries.

Several studies implemented in the region some of them through a technical cooperation, as environmental isotope hydrology applications in most of the MENA countries for hydrological investigation, paleo-water and fossil groundwater studies, pollution and pollutants transport for water protection. This is mainly through a regional technical cooperation projects with the International Atomic Energy Agency (IAEA) and cooperative involved organizations, also with involvement of other regional laboratories in the Maghreb and Mashreq Arab countries as the regional Isotope laboratory in the Water Authority of Jordan (WAJ). Actually the application included of stable isotopes of Oxygene-18 (18O), deuterium (2H), Carbone-13 (13C) and radioactive isotopes mainly for Tritium (3H) and Carbone-14 (14C), and others.

Taking into consideration the water scarcity, rainfall irregularity, variability of drought events,… water vulnerability to contamination and pollution risks, indicating that Integration of nuclear techniques to a quantitative and Qualitative models in water resources management can significantly reduce the cost of investigation and exploration and potential water resources exploitation..

The existing groundwater use in the MENA region caused severe depletion of the groundwater table and equipotential heads. These regional aquifers especially the non-renewable groundwater exploitation at the MENA region, needs to be improved for a shared use of mega water basins in a regional basis, also highlight to sustainability and management of the non-renewable fossil groundwater. It is essential, application other environmental isotopes as Chlorine-36 (36CL) for groundwater dating especially for the confined groundwater systems, so could be necessary sampling the Chlorine-36 (36CL) /or Uranium isotopes to address the mixing/flow of very old groundwater. Accordingly increased the use of environmental isotopes for effective management, especially in water scarce areas.

استثمارات المياه الجوفية من الطبقات المائيه العميقه في الاحواض المائية الكبرى في الوطن العربي

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الملخص

تبلغ مساحة الوطن العربي 14.20 مليون كيلو متر مربع، لكن معظم هذه المساحة الشاسعة تقع في المناطق الجافة التي لا يـــزيد معدل الهطـــول فوقها على .100 mm/year

ان المياه السطحيه ما زالت تمثل الجانب الاكبر لمصادر المياه في كثير من دول العالم العربي كما تبين الانهار الرئيسيه بان نحو 60 بالمئه من مياهها ياتي من خارج الوطن العربي.

تأتي بشكل رئيس من أحواض النيل والفرات ودجلة والسنغال وشبيللي وجوبا والقاش.

ونظرا لزيادة الاستثمارات في الفتره الاخيره في الوطن العربي في جميع القطاعات فان ذلك سيؤدي الى ضغوط كبيره على مصادر المياه المتاحه ومن ضمنها مصادر المياه الجوفيه العميقه وغير المتجدده. وللتغيرات المناخية المتوقعة، وتكرارموجات الجفاف التي تسيطر على المنطقة منذ عقود، والتأثيرات السلبية المتوقعة مستقبلاً في الأنظمة المائية السائدة, فإنها تعيش حالة من العجز المائي المتفاقم، ومتوقع وصول العجز المائي بحلول عام 2025 إلى حوالي 220 مليار م3 سنوياً.

فقد كشف تقرير دولى صادر عن برنامج الأمم المتحدة الانمائى، أن إمدادات المياه فى المنطقة العربية ستصل فى عام 2025 إلى 15% مما كانت عليه عام 1960 بسبب تغيرات المناخ والنمو السكانى والاقتصادى.

الادارة التشاركية لمياه الري في وادي الاردن

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الملخص

تعتبر تجربة الإدارة التشاركية لمياه الري في وادي الأردن من خلال جمعيات مستخدمي المياه من التجارب الرائدة والمميزة حيث تبنّت سلطة وادي الاردن هذه التجربة كخيار إستراتيجي ضمن خطتها الاستراتيجية من أجل تحسين إدارة مياه الري وتقليل الفاقد علاوة على المحافظة على مصادر المياه وأنظمة الري .

بدأت فكرة مشاركة متلقي الخدمة (المزارعون) في إدارة مياه الري عام 2001 وذلك بالتعاون مع الوكالة الألمانية للتعاون الدولي ((GIZ حيث تم العمل في مناطق ريادية من أجل تشجيع متلقي الخدمة على تبني هذه الفكرة و مشاركتهم في إدارة مياه الري جنبا إلى جنب مع سلطة وادي الأردن.

وقد مرت هذه التجربة بالعديد من المراحل تمثلت أولاً ببناء الثقة ما بين كوادر سلطة وادي الأردن ومتلقي الخدمة , ومن ثم تم العمل على تأسيس جمعيات مستخدمي المياه تحت مظلة المؤسسة التعاونية الإردنية , في ذلك الوقت عملت كوادر سلطة وادي الأردن و بالتعاون مع فريق المشروع ((GIZ على تدريب لجان الإدارة في هذه الجمعيات على مهام توزيع مياه الري.

في بداية العام 2008 كانت أولى خطوات نقل بعض مهام ادارة مياه الري في سلطة وادي الأردن إلى جمعيات مستخدمي المياه وهي مهمة توزيع مياه الري على الوحدات الزراعية. جنباً إلى جنب دأبت سلطة وادي الأردن وفريق المشروع إلى تأسيس جمعيات مستخدمي المياه ونقل المزيد من الصلاحيات حتى وصلت لغاية عام 2017 إلى 22 جمعية , 18 جمعية منها وقعت إتفاقية نقل بعض المهام من سلطة وادي الأردن , أما باقي الجمعيات فهي في مرحلة التدريب والمشاركة التطوعية , وما زال العمل مستمراً لتغطية كافة المناطق الزراعية في وادي الأردن وصولاً إلى الإدارة المتكاملة في مياه الري . حيث بلغت نسبة التغطية للادارة التشاركية من مساحة وادي الاردن 86% , ونسبة المشاركة بعقود نقل مهام 51% من مساحة وادي الاردن.

Moderate and Excessive Consumption of Pure Water During the Process of Manufacturing Jordanian Phosphate

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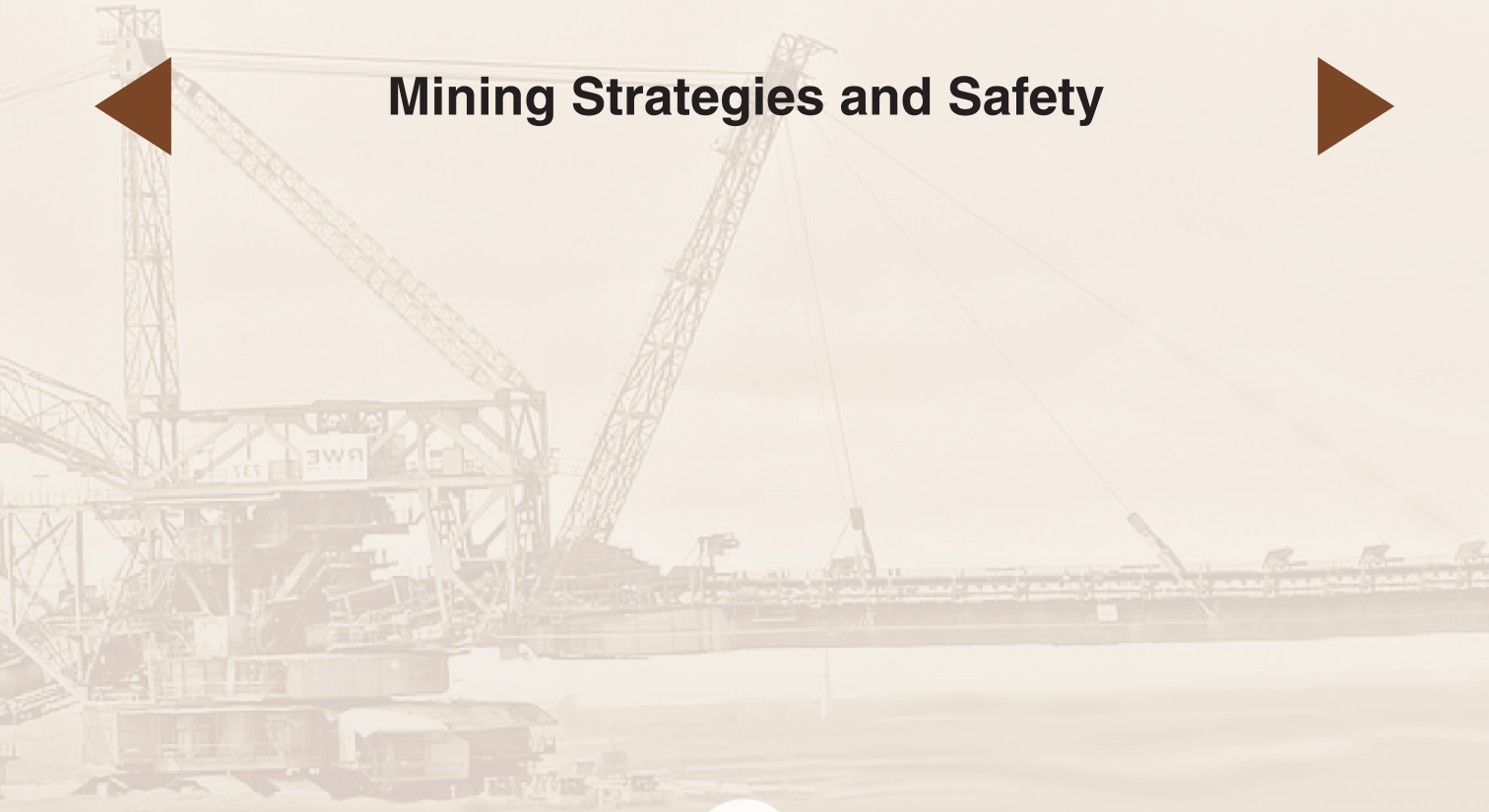
Abstract

It is well known that there are four main ways to treat phosphate in order to increase its grade (beneficiation) .....

The uses of these methods vary according to the difference ofimpurities accompanying the phosphate ore.

Mining Strategies and Safety



DIFFERENT METALLURGICAL PROCESSES APPLIED FOR THE DEVELOPMENT OF COPPER ORE RESOURCES

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Abstract

Metallic ores are present in different types of deposits around the world, such as in copper ore resources. Clearly, metallic ore deposits are the most abundant. As is well known, metals are used in all modern human activities, and they have been exploited since the raising of the human civilization. Even though metallic ore deposits are spread all around the world, specially copper ores, the grade for a copper ore resource to be considered attractive has decreased from metallic-native copper, pure metallic ores of >80% Cu to 4% Cu content to the now low limit of economic copper ores of 0.4% Cu for certain copper sulfides deposits. Therefore, technologies to be applied to copper ore resources from exploration to exploitation and metallurgy depend on the origin of the deposit and the mineralogy of it. The copper mineral species present defining the metallurgical processing of the copper ore.

In the case of the Kingdom of Jordan, little to no information on copper ore resources was obtained from literature. Personal communication was necessary with Eng. Ibrahim Rabba. In his MPhil. Thesis, Chapter 4, Eng. Rabba described ten hand specimen size samples. Using transmitted light microscope, X-ray powder, and electron-probe micro-analysis, it was identified chrysocolla ($CuSiO_3.2H_2O$) followed by malaquite ($Cu_2CO_3(OH)_2$) as the most abundant mineral species in the Finan and Timan deposits. In addition, planchite ($3Cu.SiO_5.H_2O$), atacamite ($Cu.Cl_2.3Cu(OH)_2$), besbeeite ($Cu.SiO_3.H_2O$), and mottremite ($(CuZn)PbVO_4.(OH)$) copper minerals were identified. In general, these mineralogical species were observed filling cavities, fractures and cracks as well as granules scattered in sandstone units with quartz, and in Numayari dolomite veins and in the Umn El Ammad and Wadi Khalid areas. An interesting fact corresponded to the presence of barite ($BaSO_4$) associated with the scattered grains, which indicated igneous origin (hydrothermal veins and replacements). In the case of malaquite, it occurred as cement for grains of quatz, among planes of cross-bedding indicating deposition, synsedimentary of sandstone, cement and replacement of chrysocolla.

Copper ores could be present in different types of deposits from sedimentary, metamorphic, and mainly igneous. However, the source of copper is traced to igneous-hydrothermal origin, which could result in deposition in veins, ore bodies, etc. Therefore, the primary hydrothermal intrusion of magma fluids rich in copper may be worked by the elements and re-deposit as synsedimentary, and/or transformed into metamorphic type deposits. Consequently, studying copper ore resources would require to evaluate not only oxidized out-crust part of the deposit, but to perform deep exploration drills to obtain cores from the oxidized more superficial zone, follow by the intermediate zone where secondary enrichment copper sulfides are found such as covelite (CuS) and bornite (Cu5FeS4), to the primary zone where primary sulfides such as chalcopyrite (CuFeS2), chalcosite (Cu2S), bornite, etc. are present. In general, the primary copper sulfides constitute the main part of the deposit, and it could be present as veins, ore bodies, or porphyritic or disseminated copper ore. Copper sulfides minerals correspond to three distinct groups: Pure sulfides: Cu2S chalcocite (79.8% Cu) and CuS covelite (66.4% Cu); iron-copper sulfides: CuFeS2 chalcopyrite (34.5% Cu and 30.5% Fe) and Cu5FeS4 bornite (63.3% Cu and 11.1% Fe); and complex sulfides: Cu3AsS4 enargite, Cu2FeSnS4 stannite, and Cu3SbS3 tetrahedrite; so called sulfo-salts.

Even though limited information on the Jordanian copper ore resources is available in literature, the one available point out towards igneous origin deposits. In general, copper ore resources are determined and defined not only using prospection, geological recognition, and exploration but by a well structured drilling program with deep-long holes to produce strategic information by analyzing the cores obtained from diamond drills (DD), reverse circulation (RC) or new-advanced sonic drilling. In order to review the metallurgy of copper ore resources, a hypothetical deposit containing an oxidized out crust, an intermediate secondary enriched copper sulfides zone, and a primary copper sulfides zone is visualized. This paper would only give a general view of the copper ore resources metallurgy and it wills not intent to describe in detail any unit operation, technology, or process. Reference for the technologies presented are based on the Copper Industry of Peru, Chile, USA, and Canada.

First, crushing has to be considered independent of the copper ore resource zone. However, the final crushed material size would depend on the metallurgical process designed for the downstream operations, the capacity, and the zone of the deposit considered. Gyratory crushers

(high capacity, large size material fed, and coarse product of about 5080- mm) correspond to the first stage of crushing, follow by one to three stages of cone crushers (products about 2.03.0- mm), and finally tertiary crushing on specially design cone crushers (product <1.0 mm). There could be other type of crushers to be used in all these crushing stages, such as jaw crushers, roll crushers, impact crushers, etc. However, it is important to point out the high pressure grinding roll (HPGR) as a most efficient comminution system between the secondary, tertiary crushing, and even partial grinding stage. Here, bed comminution is the predominant mechanism, which could result in even selective comminution.

In general, the development of copper ore resources is designed for large capacity processes, which consider storage steps from out of mine to fine crushed material, using stock piles, feeding pockets or bins, and transfer bins. Following these crushing steps, it requires to continue the comminution of the ore by grinding from coarse (rod mills), middle and fine (ball mills) to ultrafine (vibrating minerals, vertical mills, ISA mills, etc.), which depends on the economic liberation size of the copper minerals, the metallurgical process used or available, and the downstream unit operations.

Since multiple mining methods are designed and available depending on the state of oxidation, origin, and natural re-working of the deposit, this paper will not focus on mining. It is assumed that whether open pits, trackless, or underground front systems are used, the appropriate metallurgical technology is to be applied.

In the case of copper oxides, such as cuprite, chrysocolla, malaquite, atacamite, etc., several options are available. Flotation is possible, but it is not considered the first option due to limited success and complicate surface chemistry. For example, flotation is used in combination with sulfidization (use of Na2S or NaHS) to transform the surface of the mineral into that of the equivalent sulfide. This is used mainly for carbonates, sulfates and oxides. Other mineralogical species, such as chrysocolla, atacamite, and other copper silicates have been floated using hydroxamates and hydroxamic acid derivatives. Extensive research and development is taking place in this area relating crystal chemistry and surface chemistry to develop a selective, efficient, and economic flotation process of oxidized copper ores. By far, the most common metallurgical technology applies for copper oxidized ores is leaching mainly using sulfuric acid (H2SO4) as the leaching agent. Great advances have taken place in leaching of copper

oxide ores: The stock piling of crushed copper ores to just about 50mm to 38mm, the sealing of the stock pile leaching area during the preparation of the stock pile, technology to avoid channeling and blinding of the piles, better distribution of the aqueous leaching acid, recovery of the pregnant solution, and the purification/filtration of the liquor. Also, extensive work has been made to develop other leaching agents, such as ammonia-thiosulfate. Other leaching methods may include vat vessels, agitation tanks, etc. depending on the capacity, leaching kinetics, and characteristics of the ore.

Independent of the leaching agent, the loaded liquor requires being purified/filtered to proceed to the recovery of the copper contained. The most common route after a clear (free of particles) liquor is obtained, it is the use of solvent extraction. This process consists of two unit operations, the transfer if the copper ions from the aqueous liquor to an organic phase (organic reagent), and the stripping unit operation, where the organic phase releases the copper ions into a pure copper aqueous solution. Once pure copper aqueous solution is obtain, electrowinning will transfer the copper from solution to be deposited in a metallic copper cathode producing >99.99% copper cathodes, the final product of this process. This route requires auxiliary installations and processes to deal with degraded organics, potential impure solids residues, large consumption of electricity (which has to be available), handling of both diluted and concentrated solutions, and copper cathodes (solids).

Depending on the economics, precipitation of metallic copper from copper acid solutions has been used since the first half of last century, the Cementation Process. The Cementation Process consists on the use of the oxidation-reduction potential to precipitate copper using scrap iron, which is dissolved. This process is carried out in launders or in tumbling drums producing slurry that reaches 70% to 83% metallic copper content. Here, the control of the pH of the solution, and its composition is critical since ferric ions are to be avoided. Ferric ions will undo this process by re-dessolving the precipitated copper. Downstream unit operations include solid/liquid separation, filtration and drying. This copper cement is usually processed using pyrometallurgical routes.

Contrary to the case of oxides, copper sulfides whether secondary or primary are mainly processed using flotation, previously being adequate grind for the economic liberation of the copper minerals. For this purpose, thio-compounds are mainly used as collectors, thicarbonates

(xanthates and dialkyl xanthates) being the most commonly used. However, several types of thio-compounds are used, such as mercaptans, dithio carbamates, dithio phosphates, thiocarbanilides, and mercaptobenzothiozoles. Also, non-thio ionizable compounds are used both as collectors and frothers, such as alcohols, aldehides, amides, and esters. Copper sulfides flotation is based on chemisorption of the collectors; thus, a slow adsoption process (overcoming the thermodynamic barrier), but more selective. Therefore, copper flotation requires a long conditioning time with collectors and modifiers at pH above 8.0 (up to pH 11.0) since pyrite is one of the main contaminants. The surface chemistry of copper sulfides resulted also in long flotation time (slow kinetics) and complicated and extensive circuits whether using mechanical (sub-aeration, forces aeration, etc.), pneumatic, columns, jet types, etc. Consequently, flotation circuits include long rougher circuit follow by several stages of scavenger flotation cells. Recirculation of products is the norm in this type of circuits, so large circulation loads are possible. Similar type of design is used for the rougher concentrate handling, which is cleaned in several cleaner, recleaner, and re-recleaner cells before a final concentrate of adequate grade and low contaminants is obtained. This implies large ratio of concentration, which means treating of large amount of material to produce a limited amount of product(s). The copper concentrates after thickened, filtered, and dried are sent to pyrometallurgical extractive routes. Usually, the concentrates are blended, smelted (Reverver furnaces or flash smelters), oxidized in a converter, and de-oxidized in an additional furnace to cast the metal into copper anodes. Then, electro-refining of these anodes is carried out in electrolytic cells using $CuSO_4/H_2SO_4$ as electrolyte. Here, the copper anodes are dissolved and the copper re-precipitated in the cathode with a purity of >99.999% Cu. Also, a residual anode sludge could be produced which may contain valuable impurities, such as gold and silver that are recovered in secondary metallurgical processes.

Hydrometallurgical processes have been applied to the processing of mainly secondary copper sulfides. These processes correspond to stock piles (not as much used as for oxides), agitated tanks, and pressure leaching in vessels. Besides the use of aggressive chemicals (nitric acids, chlorine, etc.), bacterial leaching using thio-bacillus ferrooxidans, ferro-bacillus ferrooxidans, thio-bacillus concretivurus, etc. to dissolve copper sulfide ores are considered. The remaining of the metallurgical processing of the dissolved copper from these ores is similar to that for

oxides, which follows the purification/filtration, solvent extraction, and electrowinning route.
In summary, copper ore resources could be developed using a large variety of technologies, unit operations, and processes. It is of utmost importance to define the resources; characterize it, the ore, and the copper minerals; and follow the most convenient route to obtain an economical product from the copper ore resources; whether a copper concentrate, copper cement, or metallic copper of the highest purity possible. Also, this implies a great variety of well prepared engineering expertise. This paper is aimed only at showing large possibilities in dealing with copper ore resources, and not to deliver technical details of the different topics.

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Prospects of using solar Energy in Mining and Minerals processing industry

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Abstract

The current market for minerals commodities suchas phosphate, oil shale, and cement is very competitive, and the main goal of any project is to reduce the production costs in order to be competitive in the market. one of the key factors that contribute significantly to the production chain is the cost of energy. In Jordan these project were located in remote areas with a plenty of sunshine almostthroughout the year, therefor there are opportunity to utilize electricity from solar energy either by traditional photovoltaic(PV) technology or by more advanced technologies such as concentrated photovoltaic cells (CPV) or solar concentration collectors such as parabolic troughed collectors(PTC) . In this paper a general overview of these technologies will be given. A worked example evaluating the cost of energy in a proposed minerals processing circuit showing the prospects of using solar energy will also be given.
Keywords: phosphate, oil shale, cement, solar energy, collectors

Sustainability of Mineral Reserves in Jordan: The case of Phosphate and Potash

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Abstract

The purpose of the paper is to estimate the level of necessary reinvestment 'user costs' needed to repay forthcoming generations for the depletion of phosphate and potash reserves in Jordan. El Serafy equation technique has been used to estimate the user cost for both resources from 2002 to 2015. On a discount rate of 3%, phosphate resources had a user cost of $US 0.99 million in 2002, $US 0.86 million in 2005, $US 0.09 million in 2010 and $US 1.22 and $US 1.76 million in 2014 and 2015 respectively. Also on a discount rate of 3%, potash resources had a user cost of $US 10.13 million in 2002, $US 41.39 million in 2005, $US 92.07 million in 2010 and $US 24.86 and $US 78.75 million in 2014 and 2015 respectively. The Sustainable Budget Index (SBI), used to measure whether the user cost was reinvested or used for public consumption, surpassed 1.0 from 2002 to 2015 which indicated that mineral revenues have been used for public consumption rather than for investment purposes.

Toxic Metals Distribution and Extraction from Two Forms of Exhausted Oil shale

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Abstract

The distribution of toxic heavy metals in different forms of processed oil shale was investigated in this research work. Both XRF and proximate analysis were used to follow up metals distribution in processed oil shale. For comparison purposes, the levels of metals were also quantified in unprocessed oil shale. Upon processing oil shale, many heavy metals were concentrated in the final residue. The most concentrated metals were Cr, Cu, Co, and V with enrichment factor more than 2.0 in both solid forms. Compared with raw oil shale, leaching of toxic heavy metals was increased many folds and percentage of extraction was higher than 60% of all metals using HNO3. Total characteristic leaching test (TCLT), a standard test to stimulate metals elution in the environment, confirmed that retorted oil shale was more toxic when contacted with aquatic environment. TCLT indicated that the released amount of Cr was 4.4 higher than the safe limit set by international agencies.

Using of Activated Oil Shale for the Removal of Heavy metals from Aqueous Solutions

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Abstract

The purpose of this study is to evaluate the possible use of locally available oil shale as a raw material, thermally activated and chemically activated in the removal of Cu2+ and Zn2+ from aqueous solution by adsorption .The effect of different operation parameters such as concentration of heavy metals, sorbent concentration and time on the uptake of heavy metals by this adsorbent is studied. It was noted that Oil shale is able to remove appreciable amounts of copper and zinc ions from aqueous solutions. An increase in the adsorbent concentration with constant copper or zinc concentration resulted in greater metal removal from solution. An increase in the copper or zinc concentration with a constant sorbent concentration resulted in higher metal loading per unit weight of sorbent.Langmuir isotherm model was found to be applicable for the experimental data of Cu2+ and Zn2+. The results showed that oil shale could be used for the adsorption of the Cu2+ and Zn2+, the chemically activated oil shale is giving the best removal for Cu2+ up to 99% and thermally activated oil shale is giving the best removal for Zn2+ up to 99%.

استغلال الثروة المعدنية الوطنية في الأردن

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الملخص

في ظل الاوضاع الاقتصادية الصعبة التي تمر بها المملكة وعجز خزينة الدولة والمديونية المتراكمة المتزايدة والبحث عن المنح الدولية للخروج من الازمات المتتابعة التي يواجهها الاردن، الامر الذي ادى الى تخبط اصحاب القرار في البحث عن حلول لم يجدوا لها الا طريقا واحدا «وهو جيب المواطن».

وبالتزامن مع كل تلك التخبّطات يسعدني ان ابين هنا بان الاردن يملك ثروة معدنية تكفيه لتغطية مختلف المشاكل الاقتصادية التي مر بها الوطن سابقا وحتى يومنا هذا، مبيناً ادناه اهم المعلومات والنتائج التي توصلت اليها من خلال ابحاثي ودراساتي التي قدمتها بعد الدكتوراه وقبلها في جامعة لندن ، والمتعلقة بالجدوى الاقتصادية لمجموعة المعادن الصناعية الاردنية الرئيسية التي عملت بها وقمت بدراستها منذ بداية الستينات، وخاصة منها ما يتعلق بمعدن «النحاس» والكميات الكبيرة الموجودة في باطن الارض الاردنية منها وبالتحديد في منطقة وادي عربة، وعوائدها الايجابية المتوقعة على الاقتصاد الاردني.اود في بداية حديثي عن المعادن في الاردن، «وبالاخص معدن النحاس في وادي عربة ابتداء من عام 1962 ، حيث كنت عُيّنت آنئذٍ مشرفاً ممثلاً للحكومة في مشروع النحاس من وزارة التخطيط (مجلس الإعمار سابقاً) للقيام بالتعاون مع شركة ‹اوتوجولد› الالمانية في مجال التنقيب عن النحاس ضمن برنامج المساعدات الالمانية التي قدمتها للاردن آنذاك بقيمة 180 الف دينار»، والتي توصّلتْ من خلالها الشركة الالمانية الى اكتشاف مجموعة من المعادن الصناعية الاردنية الرئيسية التي تتواجد بكميات تجارية كبيرة وهي ‹النحاس والمنغنيز› والتي قمت بدراسة جدواها الاقتصادية والفنية بالاضافة الى دراسة 20 معدن آخر من المعادن على اساس كمياتها ومواقع تواجدها.وبالتركيز على معدن النحاس، فقد اكتشفنا كميات كبيرة من النحاس الخام في منطقة وادي عربة، وبالأخص في منطقة وادي ضانا التي كان تركيز النحاس فيها عالي (بنسبة 20-26%) مركّبة مع معدن المنغنيز بنسب اخرى عالية عالمياً. والمشكلة التي واجهتنا وقتئذٍ هي عملية فصل النحاس عن المنغنيز التي كان تكلّف مبالغ باهضة لم يكن بالامكان توفيرها من أسعار البيع، بالاضافة الى تكاليف استخراجها من الباطن. وكانت النتيجة الاخرى ايضا اننا اكتشفنا النحاس في مناطق أخرى جنوب منطقة ضانا هي: وادي ابو خشيبة (بطول 70 كم وعرض 20كم بالمعدل) الذي يقع في شمال ووسط وادي عربة بمعدل تركيز 0.8-1% والذي لم يكن ممزوجاً مع اي معادن اخرى وعملية استخراجه وصهره لا يكلف الكثير على شكل كبريتات النحاس.

استغلال وتعدين الصخر الزيتي في الاردن ودور القوانين والتشريعات المنظمة في المحافظة على البيئة واستدامتها

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الملخص

تعتبر الثروات المعدنية والمتواجدة في العديد من الدول العربية ذات اهمية في تعزيز النمو الاقتصادي والتجاري للدول العربية حيث ان الاستخدام الامثل لتلك الخامات واستغلالها , والاستثمار من خلال اتباع الانظمة والقوانيين البيئية والتي تضمن ديمومة استغلال الثروات المعدنية والمحافظة على البيئة من التلوث ويسمح ببيئة محيطة تضمن استمرارية عمليا الاستغلال والتعدين .

تتواجد في الاردن العديد من الخامات المعدنية الفلزية والغير فلزية , و منها ما هو مستغل ومنها لايزال في طور الدراسات والتقييم ومن اهم تلك الخامات خامات الصخر الزيتي و يعرف الصخر الزيتي بانة صخر رسوبي مكون من الحجر الجيري والمارل الطباشيري ويحتوي على مواد عضوية غير ناضجة وتعتبر خامات الصخر الزيتي مصدرا هاما من مصادر الطاقة حيث يمكن انتاج الطاقة الكهربائية ناتج عمليات الحرق المباشر للصخر الزيتي وانتاج النفط والغاز بعد تسخينها على درجات حرارة تصل الى 500درجة مئوية

تتواجد خامات الصخر الزيتي في الاردن بكميات واحتياطيات كبيرة تقدر بحوالي 23 مليار طن وتحتوي هذه الصخور على نسبة مرتفعة من زيت تصل الى 15% من النفط والغاز ومعادن اقتصادية نادرة هامة .

لقد قامت الحكومة الاردنية بطرح مناطق شاسعة للاستثمار في الصخر الزيتي لشركات محلية وعربية وعالمية , وقد تقدمت العديد من الشركات المحلية والعالمية لاستثمار في الصخر الزيتي اما لتوليد الطاقة الكهربائية من خلال الحرق المباشر او تقطير الصخر الزيتي بعد حرقة وقد تقدمت العديد من الشركات وتم منح حقوق تعدين للعديد من الشركات المحلية والعالمية وهنالك خمس شركات تعدين محلية وست شركات عربية وعالمية منها شركة شل العالمية وشركات سعودية واستونية وهندية وصينية حصلوا على حقوق تعدين ومن المتوقع المباشرة في الانتاج في المستقبل القريب

ان تعدين و استغلال الصخر الزيتي من خلال عمليات التعدين والحرق المباشر, له اضرار بيئية كبيرة , وذلك ناتج عمليات الحرق المباشر للصخر الزيتي لإنتاج الطاقة الكهربائية او الحرق لعمليات التقطير حيث ينتج غاز الكبريت وغازتاني اكسيد الكربون بكميات كبيرة وهي غازات سامة ومخلفات عمليات التعدين والحرق , ولها اضرار بيئية مدمرة على البيئة إضافة بان عمليات الحرق بحاجة الى مياه بكميات كبيرة لذلك اولت الحكومة الجانب البيئي

الاهمية القصوى وذلك لمعرفتها بالإضرار البيئية الناجمة عن عمليات التعدين والحرق , قامت الحكومة الأردنية بسن التشريعات والقوانيين البيئية والتعدينية الصارمة والملزمة للشركات التعدينية للمحافظة على البيئة من انبعاث الغازات السامة وضمان استدامتها وعدم استغلال مياه الشرب في اماكن التعدين , وانما اجبرت الشركات بالبحث عن مصادر مياه غير نقية لاستخدامها في عمليات التصنيع , وعلى الشركات وضع مخططات بيئية واضحة تضمن التزود بالمياه واتباع تقنيات حديثة للمحافظة على البيئة وضمان عدم انبعاث الغازات السامة الى الغلاف الجوي وحسب التعليمات والقوانين الاردنية والعالمية المنظمة لذلك.

وستتطرق ورقة العمل شرح مفصل عن عمليات التصنيع والانظمة والتشريعات التعدينية والبيئية المنظمة التي اقرتها الحكومة الاردنية مؤخرا , وادرجتها ضمن الاتفاقيات المبرمة مع الشركات المحلية والعالمية لضمان المحافظة على البيئة وضمان استمراريتها

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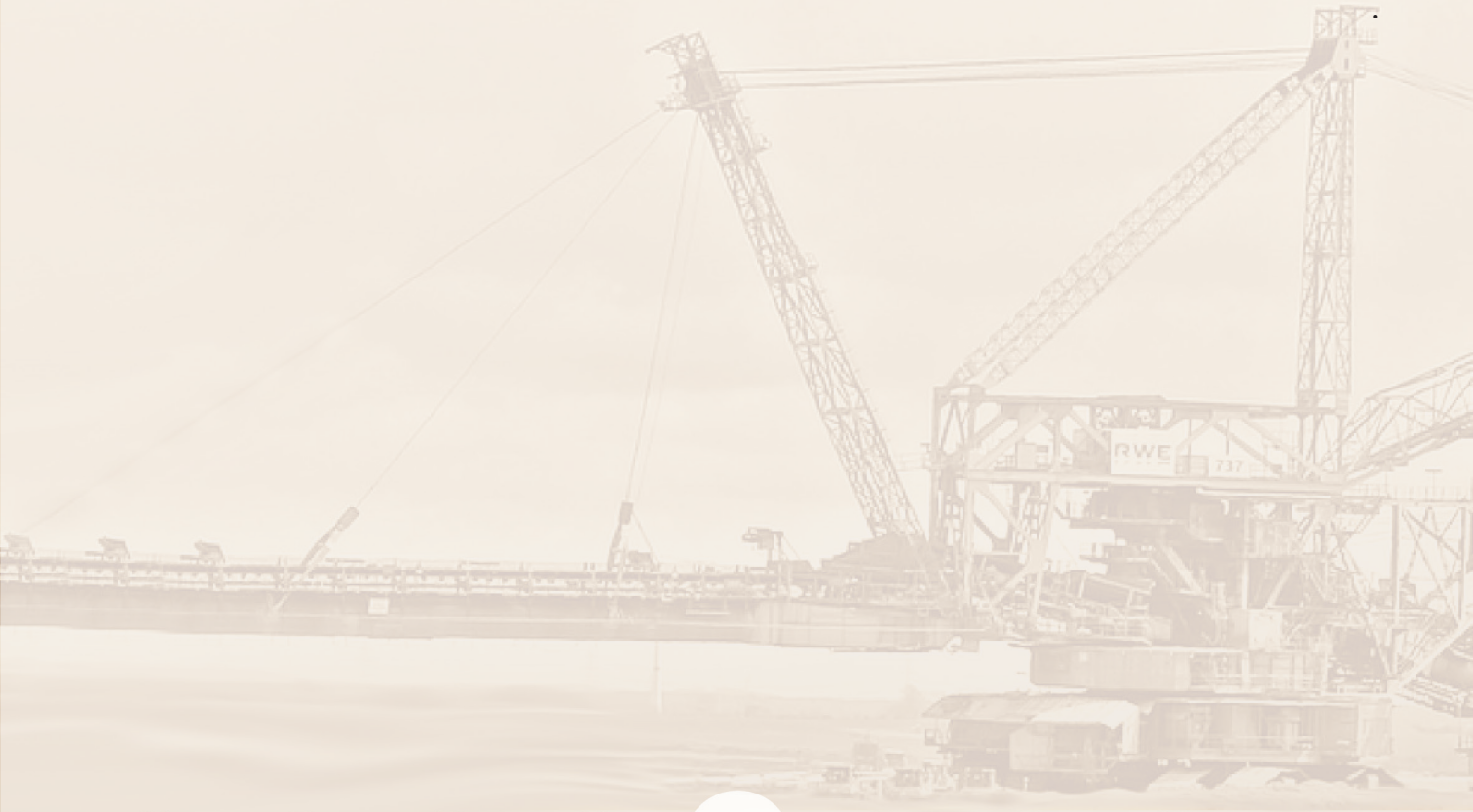

دور وأهمية التحاليل الكيميائية في خدمة الاستثمار في قطاع التعدين

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الملخص

تعد الثروة المعدنية في اي بلد احد اهم الموارد الهامة لتحقيق الاهداف الاستراتيجية في تنوع القاعدة الاقتصادية .

ان اعمال التحري والاستكشاف والتنقيب عن الخامات المعدنية وبيان القيمة الاقتصادية والمعدنية لا تكتمل الا باجراء التحاليل الكيميائية والفيزيائية اذ ان نتائج التحاليل هي الفاصل في تقييم الخامات وبيان القيمة الاقتصادية.

Keynote Speeches

UNDERSTANDING A PHOSPHATE ORE AND THE ENGINEERING PRINCIPLES TO BE APPLIED: Key Steps for a Successful Beneficiation of the Ore

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Abstract

The demand for food in the world will continue to show strong growth due to several important factors, such as population growth mainly in the middle income countries from 5.3 billion in 2015 to 6.8 billion in 2050E. This world's population growth results in increasing the estimated Gross Domestic Product of 2.5%-3.0% up to 2017. Therefore, the growth consumption of agricultural products will be driven by the increase in income in the middle and low income countries resulting in an increase of 8% and 9% of Daily Protein Intake per Capita (g/day/person) by 2024E. This corresponds to increasing billions of agriculture products of grains, oilseeds, and sugar estimated in 58- billion up to 2024E.

The Kingdom of Jordan has world class phosphate mines in a world that is full of poor soils lacking of nutrients, which creates a huge demand for fertilizers NPK (nitrogen-phosphorous-potassium). Jordan holds large phosphate mines, Eshidiya Mines, with 731.5 Mt of measured and indicated reserves and 350 Mt of inferred resources. The deposit considers three types of ores: Phosphate Ore Type A1, which requires only washing; Phosphate Ore Type A2, which is direct shipping ore (DSO); and Phosphate Ore Type A3, which requires washing and beneficiation including flotation. The three types of phosphate ores produced 5.2 Mt of products per year. Jordan may consider as potential markets for its phosphate rock the EU, Russia, Africa, and even North America.

Therefore, it is of utmost importance to discuss the technical aspects of the Phosphate Industry since the economical success of Phosphate Rock commercialization in a competitive world requires sound and efficient engineering and technology. Even though I will concentrate on washing and beneficiation of the phosphate ore, it is important to define the type of deposit between sedimentary, igneous, metamorphic, and organic (Guano) since the technology applied depends on the type of deposit. Jordan, phosphate deposit is considered a sedimentary deposit.

Next, a good metallurgical processing design of phosphate ore deposits start with a good understanding of its geology. In general, a good understanding of the geology is a constant task of exploration, drilling, sampling, and evaluation to obtain the basic information for not only interpret the deposit genesis and define the exploitation mining methods, but more important for the metallurgist, the acquisition of representative samples. These samples are of utmost importance to carry out studies from the conceptual design of a suitable metallurgical process to the control, improvement, and modifications required to maintain the technical excellence of the phosphate ore washing and beneficiation. Based on these objectives, Characterization Studies of the representative samples would allow the metallurgist the opportunity to take advantage of the proprietary characteristics of the phosphate ore. These Characterization Studies are not limited to chemical analyses, screen assays (size by size analysis), or mineralogical studies and QEM Scan (Quantitative Electron Microscopy Scan), X-Ray diffraction, EMPA (Electron Micro Probe Analysis), but include physical characterization, such as specific gravity (Sp.G), apparent densities, comminution parameters (SMC tests parameters and Drop Weight Index (DWi), Bond Work Indices (Wir, Wib, Impact Index, Bond Abrasion index, etc.), hardness, grindability, etc.), rheological parameters, etc. These types of studies should not only be carried out when designing the metallurgical process, but when there is an indication that a change in the characteristics of the phosphate ore may occur.

With these characterization studies, it is also important to apply the engineering fundamentals, principles of operation of different pieces of equipment and unit operations for a given process. In the case of the Phosphate Industry, there are important rules that have to be followed to achieve a successful operation according to extensive phosphate operation experience:

- Keep a steady feed load to the washer and downstream unit operations.
- Scrub strongly the phosphate ore to release clays and impurities.
- Deslime thoroughly the phosphate ore.
- Size the phosphate ore into narrow size fraction ranges.
- Condition the prepared phosphate flotation feed at the highest solids content possible when using anionic collectors as flotation reagents.
- Float at lower than 35% solids content.
- Remove the phosphate concentrate (froth) as fast as possible.

- Float to produce final tailings on each flotation stage.
- Reduce as much as possible middlings recirculation products.

Using this basic technical and engineering knowledge, the proper selection and studies of the required unit operations for the process must be carried out on a continuous basis during the life of the mine as the phosphate ore deposit changes. For example in the washing section, little attention is given to new technology, such as the potential use of selective comminution, which could be achieved by using high pressure grinding rolls (HPGR). Here, the new concept of bed comminution is applied due to the choke feed conditions of this HPGR. Under this concept, the rolls are more a conveying media for grinding of the weak-soft minerals, such as clays and carbonates by strong-harder minerals species, such as phosphate particles, silica, etc. Consequently, the weak impurities are separated from the phosphate and silica particles using a simple desliming unit operation, upgrading the phosphate ore for the required beneficiation process. In addition, washing and desliming of the phosphate ore could be enhanced using new generation of reagents to improve the aggregative stability of the phosphate ores (dispersants). Following the Phosphate Industry principles of operation, scrubbing unit operations both horizontal (drum) and vertical (attrition) are wrongfully considered simple unit operations in the beneficiation of phosphate ores. In general, the operating conditions are fixed at high solids content based only on the experience of the engineering or equipment manufacturing company responsible of designing this beneficiation step. Nevertheless, scrubbing is a complex unit operation designed to clean surfaces of phosphate mineral particles of slimes, break loose weak inclusions or attached particles of impurities, and break aggregates of clayish material. Therefore, it is considered that as high solids content as possible should be used to enhance particle-particle interactions (impact and rubbing) without taking into consideration the rheology of the system. However, scrubbing unit operations design requires studying the balance between the increase of particle-particle interactions with the cushion effect that may occur when slimes, clays, and fines decrease the availability of free water in the system, increasing the apparent viscosity of the phosphate slurry up to that of a paste consistency, the cushion effect. Thus, laboratory tests to determine the best operating conditions for the design of these unit operations are based on the highest P2O5 grade to be obtained with the lowest impurities for different size fractions.

Next in the beneficiation of a phosphate ore, it is required a good sizing of the scrubbed and deslimed phosphate ore to complete a good flotation feed preparation. This unit operation requires steady feed load and sizing in well defined narrow size particles ranges to feed the flotation process, the flotation feed.

The flotation process in the case of the Jordanian Mines corresponds to that using anionic flotation reagent (collector), which require good conditioning of the phosphate ore at the highest solids content possible. The conditioning step corresponds to the unit operation where conditions are set up for proper adsorption of the flotation reagent on the phosphate surfaces, the collector. For this purpose, the first step is to feed the conditioner at the highest solids content. Again, the balance between the proper contact of the reagents and the slurry, and the right rheology of the system plays an important role. The right pH adjustment for the actual phosphate ore (usually above pH 9.0) and any modifier reagent for the enhancement of the collector adsorption should be added before the addition of the collector and flotation froth modifiers. Since chemisorption is the mechanism of adsorption for the anionic collector, an optimum conditioning time is of great importance to be defined. Conditioners could be horizontal (drums) for coarse size fractions (usually about +0.420-mm particle size), or vertical conditioners for the fine size fractions (usually 0.420x0.050-mm size fraction). Only after a good conditioning step, it is possible to carry out a successful flotation process.

The flotation process is designed to separate in a slurry the hydrophobic particles, which are those that adsorbed the collectors from those that are kept hydrophilic. Under these conditions, the phosphate is collected in the froth and the impurities in the aqueous tailings (sink). Many types of flotation machines has been designed for this purpose, from mechanical (sub-aeration, forced aeration, etc.), pneumatic, columns, jets type, etc. In general, phosphate ore flotation circuits are short and simple with minimum recirculation of products, “or it float or it does not float.” However, some cleaning of the floated phosphate may be necessary under certain circumstances due to entrapment of impurities in a thick-viscous froth. Finally, the phosphate concentrates must be dewatered to be commercialized using thickeners and filters (usually vacuum type). Also, tailings requires to be dewatered, usually by using thickeners and a tailings pond, or directly a tailings pond. In areas of limited water availability these unit operations are of utmost importance and a must.

To summarize the message of this presentation, I would like to focus in the technical aspects that shows that each unit operation in a metallurgical process depends on the previous one, that it is of utmost importance to characterize your phosphate ore, to know it, and that understanding the technical and engineering principles of each unit operation is of great importance to proper utilize them to obtain the maximum benefit that the phosphate ore is willing to give you.

دور المنظمة العربية للتنمية الصناعية والتعدين في دعم وتطوير قطاع التعدين العربى

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الملخص

المنظمة العربية للتنمية الصناعية والتعدين، إحدى منظمات جامعة الدول العربية المتخصصة، تهدف الى تحقيق التنسيق والتكامل العربى وتعضيد قدراته في مجالات الصناعة والطاقة والتعدين والمواصفات والمقاييس بما يعزز تطوير الإنتاج والإنتاجية وذلك في إطار إستراتيجية العمل الإقتصادى العربى المشترك التى تقرها مؤتمرات القمة العربية. تتولى المنظمة في سبيل تحقيق أهدافها تهيئة المتطلبات الأساسية اللازمة لدفع عجلة التصنيع وتطوير قطاع الثروة المعدنية في الدول العربية ليواكب التطورات الإقتصادية والتكنولوجية المتلاحقة على المستوى العالمى.تعمل المنظمة على النهوض بالقطاع الصناعى والتعدينى في الدول العربية من خلال صياغة وتنفيذ برامج وفعاليات متخصصة تتماشى مع توجهات الدول العربية الأعضاء، ويتم ذلك من خلال عقد المؤتمرات والملتقيات والندوات وورش العمل وإقامة الدورات التدريبية وإعداد الدراسات وتقديم المعونات الفنية في مختلف الميادين والقطاعات ذات العلاقة بمجال عمل المنظمة وتنفيذا لخارطة طريق المنظمة 2017-2020 في قطاع الثروة المعدنية، فإن المنظمة تسعى الى تطوير هذا القطاع من خلال تشجيع نشاط الأستكشاف والتحرى المعدنى، الترويج للأستثمار التعدينى والتنمية المستدامة للثروات المعدنية العربية وذلك نظرا لما تزخر به المنطقة العربية بالعديد من الرواسب والمؤشرات المعدنية من خامات فلزية واللافلزية وصخور ومعادن صناعية متواجدة في عدة مناطق ذات بيئات جيولوجية متنوعة. ولتشجيع الاستثمار في قطاع التعدين والصناعات القائمة عليه، الذى يمثل أحد أهم الركائز الإقتصادية للدول العربية، تسعى المنظمة في تفعيل خارطة الطريق من خلال تنفيذ أنشطتها وبرامجها ومشاريعها الحالية والمستقبلية اسهاما منها في خدمة تنمية وتطوير قطاع التعدين العربى ومن أهم مشروعاتها المستقبلية، البوابة الجيولوجية والمعدنية للدول العربية AIDMO Geoportal التى تهدف خاصة الى الترويج للفرص الأستثمارية التعدينية عربيا ودوليا عبر شبكة الأنترنت.

وتهدف هذه الورقة إلى إبراز دور المنظمة في تنمية القطاع الصناعى بصفة عامة والقطاع التعدينى بصفة خاصة في الوطن العربى من خلال تناول المحاور التالية:

- مقدمة عن المنظمة
- البيئات الجيولوجية والرواسب المعدنية في الدول العربية
- الواقع الحالي لقطاع الثروة المعدنية في الدول العربية
- التحديات التي تواجه قطاع التعدين في الدول العربية
- آليات تطوير قطاع التعدين في الدول العربية
- مساهمة المنظمة في تنمية قطاع التعدين العربى من خلال أنشطتها وبرامجها الحالية والمستقبلية.
- التوصيات

نقابة المهندسين الأردنيين
Jordan Engineers Association

www.jea.org.jo

نقابة المهندسين الأردنيين

RWE