Oil Shale, 2014, Vol. 31, No. 1, pp. 1–3
doi: 10.3176/oil.2014.1.01
ISSN 0208-189X

EDITOR'S PAGE

OIL SHALE HAS MORE THAN ENERGY – ENHANCE THE VALUE BY USING THE MINERALS IN BUILDING MATERIALS

There is abundant oil shale in this world. Oil shale was formed during all ages of the Earth and can be found in many different geological strata. As a result, many countries have oil shale resources in one or more deposits. Hence you should expect that oil shale is widely used as a natural resource, proportional to its occurrence. This is definitely not the case. There was a kind of boom time some 100 years ago, when one could find small scale oil shale mining and retorting activities in many countries, especially in Europe and also e.g. in the US and New Zealand. It was also then that a large variety of retorting technologies was developed. To be precise, commercial oil shale utilization started already long before, in France in 1839. But as petroleum became more and more available and developed to be the major energy source in the world, most of the oil shale activities ceased.

Today the awareness is growing that petroleum and cheap coal will not be available forever. Development goes into unconventional oil and gas and especially into regenerative energy. The interest in oil shale is also higher than ever. Research in oil shale is on a very high level, which is, to a great extent, documented in this journal. Never before has our knowledge about oil shale deposits and oil shale properties been as far developed as today. However, what comes out of it?

If we look at today's oil shale world, we find active commercial oil shale operations only in Brazil, China, Estonia, Germany and Russia. The number of countries with oil shale resources is ten times bigger. In addition to the active oil shale operations, there are readily explored and developed oil shale deposits and projects in Australia, Israel, Jordan, Morocco and the US. This is still a small number compared to the worldwide potential.

What is the major drawback preventing oil shale from being used proportionally to its occurrence? It is the comparably low calorific value and the extreme ash content, which makes oil shale unattractive as an energy resource. Net calorific values of oil shales vary approximately from 3 to

15 MJ/kg, while the ash content ranges approximately from 50 to 75%. With these numbers it is pretty clear that in most cases oil shale cannot compete with other energy resources.

So we must enhance the value of oil shale by not only seeing oil shale as a source of energy and by giving value to its mineral part. Oil shale ash from a retorting and/or combustion process can be very interesting for the building materials industry. Oil shale minerals undergo changes and reactions during a thermal process and might finally generate pozzolanic and hydraulic properties. That means they can work as a binder in concrete, bricks or other building materials.

Due to their different genesis, oil shales have different calorific values and composition of kerogen. And they also have different composition of the mineral matrix. Some are rich in silica and others are rich in calcium. Silica rich oil shale ashes are likely to develop pozzolanic properties whereas carbonate rich materials can also develop hydraulic properties. There are even a few oil shales which have a mineral composition very close to the composition of cement clinker. What great potential!

This is not only theory. It has long been proven by a few success stories. European standard EN 197-1 comprises a cement type "Portland-Burnt Shale Cement". In this cement type up to 35% of "Burnt Shale" can be used in cement to substitute clinker. The cement constituent "Burnt Shale" must fulfill certain requirements regarding strength and soundness. If these are met, you can also use it in other standard composite cement types.

The cement plants in Dotternhausen, Germany and in Kunda, Estonia have produced cement using burnt oil shale for many decades. In Dotternhausen it is a low grade local oil shale with only 3.4 MJ/kg, which is burnt in a fluidized bed to produce a hydraulic binder and electricity. The burnt shale alone develops a strength of 30 MPa, which makes it a valuable low cost cement constituent. Holcim uses 400 000 t of burnt shale every year to substitute clinker.

In Estonia, Kunda Nordic Cement is using a certain fraction of the ash from pulverized combustion in the two big Estonian oil shale power plants. This material also complies with EN 197-1 and substitutes clinker in standard cement. Next to Estonia, in Russia, the Slantsy cement plant, which was recently modernized, is designed to use spent shale from retorting and kerogenous waste from oil shale mining to produce clinker.

China has a long oil shale history and also a long history in using oil shale minerals in building materials. The now closed Maoming oil shale factory comprised a rotary cement kiln to use the oil shale minerals. The big Fushun oil shale plant is using oil shale residues to produce building materials.

Oil shale can be used as fuel and raw material in clinker kilns, as cement clinker manufacture requires energy and minerals. This has, however, limited potential. Economically it will be more interesting whenever you can

use large quantities of treated oil shale (ashes) to produce cement or other building materials.

There are so many chances to combine the energetic exploitation of oil shale with the production of building materials. On the other hand, of course, we must also mention the limits. Beside the mineral composition you must observe the content of e.g. sulfur, magnesium, phosphate, alkali and heavy metals. In some cases these elements may put limits on the application in building materials.

In many oil shale projects ash disposal is not only a cost factor, but also represents a strong environmental impact. It is obvious that every ton which is turned into a sellable product has a double positive effect.

A lot of research work into the use of oil shale minerals is being done around the world. This should bear fruit. Whenever an oil shale project is being developed, the utilization of the mineral part should always be an integrative part of the project. For sure it will pay to find out what you can do with the oil shale minerals. It can only enhance the feasibility of the project.

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