Mine Water Issues addressed in the project train@mine

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Abstract

In the joint project train@mine two German mining companies (RAG and MIBRAG), a water consulting company (Emscher Wassertechnik) and a University (Leipzig University, chair of service management) were making up a consortium to develop professional training courses. The aim of the project was "Internationalising of Professional Training in the Mining Sector to Support Sustainability in Resource Management". Vietnams coal mining sector was chosen as an example and the state owned holding VINACOMIN acted as a local partner. A thorough assessment phase during the first year of the project revealed a number of issues that were addressed in training courses designed on a pilot scale. Four two-day pilot courses were developed: Mine Management, Project Management in Mining, Water- and Environmental Management and Occupational Safety in Underground Mines. These courses were documenting best practice in the named fields by giving lively examples of relevant proceedings and methods.

The Water- and Environmental Management course contained the four topics "Water management and safety issues", "Impact of underground mining on the land surface", "Water treatment" and "Public concerns and management". One key aspect of the first topic was the dewatering of underground mine areas with stagnant water that can endanger the mine workings by sudden water intrusion. The comparison of the working practice in a Vietnamese mine as observed during the assessment phase with the common practice in a German mine lead to the presented example. The lifespan of the dewatering example was covering several months. It started with the utilization of a 3D underground GIS System to identify the area filled with stagnant water and illustrated the technical aspects of identifying the expected water volume and the efforts made to safely dewater the area. The mining authority was permanently kept informed about the monitoring of the progress of the works. This routine action was documented and explained in the pilot course. Not only for safety reasons it was noticed that old goaf workings in the Vietnamese mine were not closed and separated from the active parts of the mine. This practice leads to a higher air ventilation and consumption in the mine as well as a higher potential for mine water reactions induced by oxidation.

Sharing of professional experiences was viewed as a beneficial way to improve best practice. We had a very positive feed back from our pilot courses, although they could not cover topics in full detail. Future effort is needed to implement full scale training, as this project was partly funded by the German ministry for education and research. Underground coal mining will be ceased in Germany within a few years. It is in general of gaining importance to secure sustainable resource management in all countries that supply resources to countries without domestic resources or resources that cannot be economically mined. Looking ahead it is necessary to make sure our environmental standards will stay valid for all our goods all along the supply chain.

Key words: Mine water, training, best practice

Introduction

The approach of our training project was not to deliver text book courses but to create custom made training courses. The idea was to bring together experts and collect upcoming questions. The advantage of this method is the involvement of the future trainees in the design of the courses. Many educational trainers support the assumption that learning is only possible through self-discovery and self-appropriation (Rodgers 1969). For that purpose a team of around ten German experts visited repeatedly the Vietnamese hard coal production region Quang Ninh and met with Vietnamese experts. The project was partly funded by a German government initiative to propagate vocational education (BEX 2016). A number of open cast mines and underground mines were visited. The Vietnamese experts were interviewed and a broad spectrum of themes were addressed. Vietnamese experts were in turn invited to visit German mines (see fig.1).

Hard coal mining in the Quang Ninh region is conducted in open cast mines and underground mines. About 20 open cast mines and 34 underground mines were producing a mass of 34 million tons in 2011 according to the data presented to the project team. The depth of the open cast mines is continuously increasing and at some places mining is switching from open cast mining to underground mining.

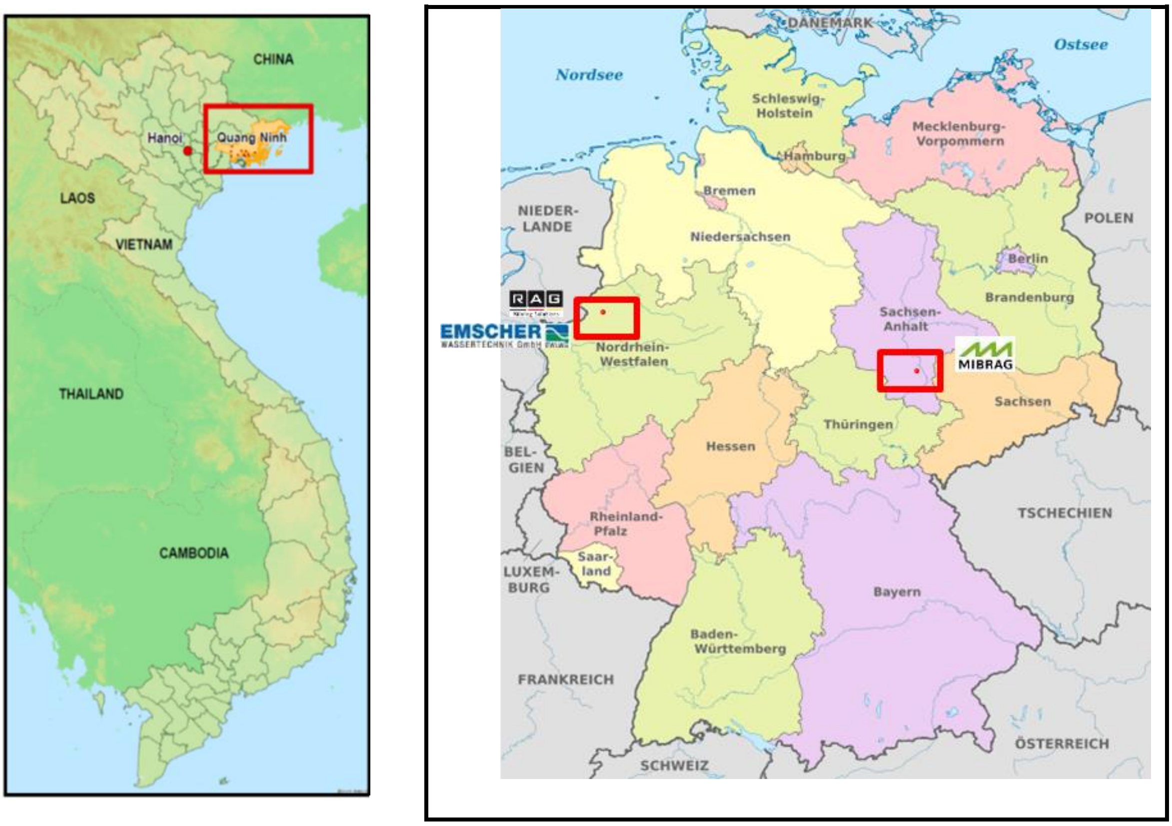

Figure 1 *Mines visited by the joint project team in Vietnam and Germany.*

To our German underground mining expert approaching the Quang Ninh mining region was reminiscent of Germany‘s Ruhr district in the early 1970s, with shades of grey everywhere, turning to black in places. The inspection report reads as follows. At the roadsides, locals would prepare meals over briquettes made from coal dust swept together and moulded in special presses. There was inadequate binding of the dust from underground, and particularly from the opencast mines, so residents could make use of the fuel they found on the surface. On arrival we saw several buildings with recreational rooms, a comparatively large washhouse for staff, a changing room for more senior staff and a small store. Our group received sets of clothing reserved for what seemed to be rare visitors – blue dungarees, a jacket, foot rags and half boots but no gloves, goggles or earmuffs. Off we went to the portal. On the way to the production site it was remarkable to see that disused roads and galleries were not dammed off. Instead, a cross made from wooden slats was put up as a No Entry sign. There was therefore a serious risk of producing fugitive air with dangerous gas concentrations. The condition of the entire roadway was not state of the art, with hardly any of the support segments connecting up to the rock. While this is tolerable at prevailing roof pressures, it would be unpardonable when mining at greater depths with running water in galleries and no pump sumps, making accidents on the travelling ways a serious possibility. The production site, with a seam thickness of about 2 m and a cutting drum in operation, lacked sufficient support resistance in the area of face-to-roadway transition. Except for a wooden prop on the face conveyor gear box, no other support segment was visible. The cutter pick had sprinkling similar to RAG's own Eickhoff cutting drums (fig. 2). Miners would walk across the conveyor and move around in unprotected environments. During the inspection, no miners who could be identified as managers were in sight. Earlier interviews had revealed the shortage of qualified personnel in this mining region, which was clearly borne out by appearances. Not a single member of staff had personal protective gear. Nearby we heard pneumatic hammers being used in manual coaling, which provides most of the output.

Figure 2 *Drum shearer seen in the visited underground mine.*

During the discussions with Vietnamese experts the two subjects in the field of mine water that attracted most interest were dealing with mine water from an operational viewpoint, and eco-friendly regional water management.

As regards mine drainage, draining dead water ("pockets" as they are known in Vietnam) was of main interest. This operation is very different from conditions in Germany where dead water is limited to regions without drainage which have been created in the rock mass by previous mining. These are visualised with a digital mine plan and provisionally drained by selective boring using highly skilled personnel underground, who have to follow very specific procedures and are supervised by the Mining Authority. When draining these regions, water pressures and flows are constantly monitored, with continuous adjustment of expected and actual readings. Safety equipment (pumps) is kept ready on site, and mine rescue squads are on standby to minimise the risk of inundation.

Training Courses

Four major topics for training courses were defined during workshops held at VINACOMIN's headquarters in Hanoi. During the workshops each topic itself was divided into subtopics according to the expressed requirements. The course Water- and Environmental Management contained four main subjects. Water management and safety issues contained the most prominent issues that had been discussed.

The mine water management of stagnant waters encountered in the underground when approaching areas that had been worked in before was extensively discussed with experts from the Auguste Victoria colliery at Marl/Germany in order to derive a model case for presentation at the pilot course in Vietnam. The methods used in Germany were debated and documented in detail to make the model as practical and comprehensible as possible. German mining techniques were illustrated by a variety of maps, sketches and photos provided by the project partners (fig. 3).

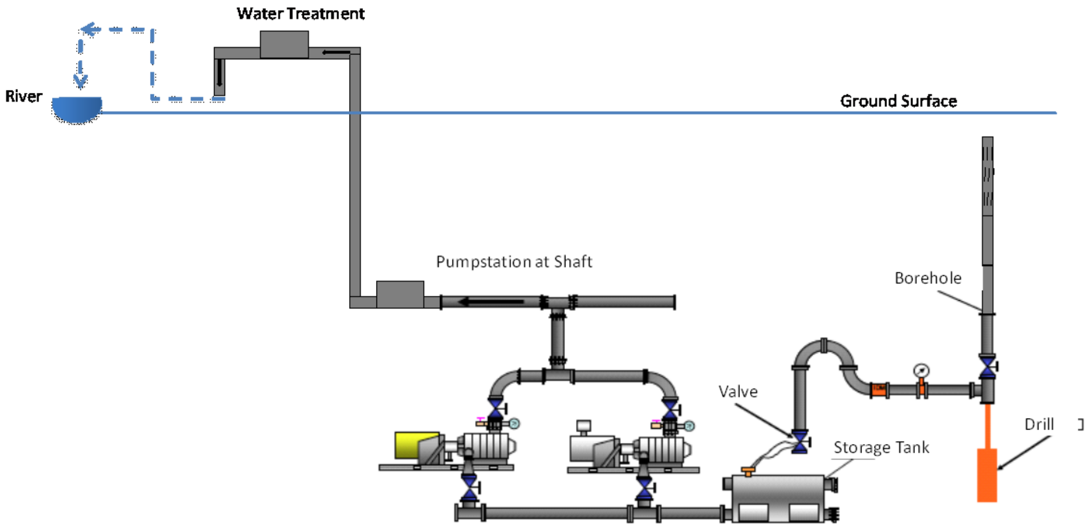

Figure 3 *Dewatering scheme to manage stagnant water in a RAG mine.*

Many of those on the Vietnamese side had been to the above mentioned colliery during an excursion organised for the Vietnamese project group. Work underground is not a prestigious job in Vietnam, and mines find it difficult to recruit suitable trainees. Mines are located in remote areas, and higher wages cannot compensate for what is available in terms of housing and leisure facilities; it remains an unattractive option. Flooding is a major risk when working underground, and water pockets may turn out to be crevasse zones with links to the surface. These are not explored in advance and are not shown in the mine plan, which consists of paper maps. In geohydraulic calculations, empirical formulas are inserted for analytical purposes without any numerical simulation. There is no close monitoring of drainage procedures by the Mining Authority. This subject was addressed in the public concerns and management part.

The pilot courses were designed to show the advantages of mechanisation in mine operations, and the German experts have tried to illustrate their own procedures in a comprehensible and practical manner. The environmental compatibility of water management in mining regions also differs from the situation in Germany. For example, a first mine water treatment plant had been built under Germany's RAME project (Bilek 2011).

At Halong, water-borne coal dust and other substances entering the bay are a major problem. In this connection, tourism can be a compelling reason for reducing the many environmental burdens generated by mining. One of the aims of the pilot course was to illustrate the German approach to mining and the environment, including forecasts of expected negative effects and suitable steps to avert or abate them. We have tried to show how planning to adapt surface starts years before mining subsidence can occur. Examples have been given of how forecasting and planning tools interact at technical level, and of cooperation between mining companies, regulatory agencies and experts at administrative level.

Mine water treatment was also discussed in detail during the pilot course. This included a presentation on general strategies to avoid or minimise the generation of polluted mine water. Details of modern and efficient mine water treatment plants recently built in central Germany were also presented, with planning and implementation described by those who had done the job (fig 4). But also technical simple in-situ-conditioning methods as operated for iron abatement in central Germany and its implementation in the mine operation processes were discussed. The idea was to convey an experience that was highly authentic, and to avoid lecturing. Some trainees knew the plants and equipment involved already from the excursion mentioned. The gathering of data needed to design a treatment plant was illustrated. In the mining context this means the prediction processes expected in the future.

Figure 4 *MIBRAG Mine water treatment plant.*

An example for unwanted effects of mining on the ground surface in Germany is shown in fig 5. In this case the anticipatory regulation of surface waters by hydraulic construction was not appropriate to avoid water logging. The negative effects had to be cured after the event. In the courses it was shown, how predictions of future ground water levels were made and how these facts are communicated with the public and the authorities. The role of certified expert referees in Germany was explained. It was presented how participation of public is organized in the process of mine planning and the planning of the compensation of negative effects.

Figure 5 *Water logging caused by land subsidence in the German Ruhr coal area.*

Conclusions

With our training courses we were able to point out a number of technical aspects that we believed are part of best practice when dealing with mine water management. On the other hand we encountered a number of non-technical reasons for many shortcomings. One reason being the lack of skilled labor. The reason for that often is that people consider the work in mines as unattractive. We met a large number of highly qualified and university/college trained managers and executives in mines, at corporate headquarters and at the Hanoi Mining University who had often studied in Germany or other countries. While modern technology is on the advance in everyday urban life, it has bypassed the workers in mining industry.

A number of parallels were found when problems in different mining regions were discussed; our Vietnamese colleagues found it hard to understand the concept of water management which involves the long-term raising of water, to be conducted in the Ruhr district in perpetuity. This is in strong contrast to the Vietnamese principle of leaving most environmental effects unregulated. The country will hopefully find a middle course here in the future. Germany’s experience in the field can be very useful, as has been confirmed by many of the trainees who attended courses in Vietnam. From our point of view, the introduction of German commercial products for education and training could be hampered by competing services granted free of charge as part of German development aid to Vietnam.

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