UNDERGROUND DEVELOPMENT – Udo Fischer, Torbjörn Hartzell and Jan Åkerman

www.mansberg.se

Udo Fischer, Torbjörn Hartzell and Jan Åkerman are inducted for developing more productive rock tools for both percussive drilling and cutting applications. During the last 50 years they have been a very creative and successful team in developing more productive rock tools and have continuously managed to surprise the market with the improvements achieved. Fischer was born 1938 in Germany. He moved 1965 to Sweden and started to work in the Sandvik cemented carbide R&D centre in Stockholm. He joined the small Rock Tool group and after a few years he was the leader of that group. The 1960s was the time when the rst generation of rock drilling tools, with brazed -at inserts used in integral tools and cross-bits, had reached the obvious end from the development point of view. The first bits with round buttons were developed during his first years with Sandvik, where all sharp corners and edges (weak points) were eliminated and Fischer played a big part in that development.

It was possible to use more wear-resistant cemented carbide grades without the risk that the decreased toughness would result in fractured tools. For tools for percussive drilling in hard rock the brazed tools also disappeared and buttons were pressed into holes with very close tolerances, which give very good support for the button. From the users' point of view, the rst type of button bit was a big improvement as a 76 mm cross bit with four -at inserts were reground 15 to 20 times during its lifetime but a button bit needed only three to ve regrinds during a comparable time.

By the 1970s demand on the tools was increasing in order to drill deeper, faster and for larger holes. The manufacturing methods for cemented carbide were ne-tuned in order to reduce defect levels and increased yield for Sandvik cemented carbide. Also work to optimise the geometries of buttons and complete tools was carried out. The much better controlled production equipment developed gave new possibilities to further optimise cemented carbide grades for rock drilling tools. However, already in the beginning of the 1980s the obvious limits for conventional cemented carbide in rock drilling tools was reached due to the fact that an increase in wear resistance by using less binder phase or more ne grained tungsten carbide always resulted in an inacceptable loss of toughness for the demanding application. Fischer and his co-workers Hartzell (born 1946) and Åkerman (born 1952) tested several new concepts with limited success. However, between 1988 and 1995 their four US patents were approved covering the new "Dual Property" (DP) cemented carbide which Sandvik says is "still the most well-known cemented carbide using macro- gradients. In the DP concept the wear resistance and toughness can be improved independently of each other in the product. Controlled re-distribution of cobalt binder phase several millimeters inside the buttons gives components which contain three distinct microstructural zones. These gradients, together with their di□erences in thermal expansion, redistribute the internal stresses. It is for example possible to create a very hard and wear-resistant surface layer which is simultaneously pre-loaded with compressive stresses to prevent the initiation and propagation of cracks. Carbide having such a distribution of properties has high wear resistance at the surface combined with a tough underlying region. The new type of tools often has double life-length compared to conventional tools especially in top hammer and Down the Hole (DTH) applications. There was also a need to develop more productive cemented carbide grades for new very demanding rock cutting applications.

The former Voest –Alpine Bergtechnik in Austria has delivered roadheaders for more than 50 years and was the rst company to develop a bolter miner for coal mining in the early 1990s. Their cooperation with Sandvik started at that time. Such machines also had big potential in salt/potash mining as well as in construction and hard-rock mining. However, more productive cemented carbide tools had to be developed. For the new application area Fischer, Hartzell, Åkerman and and coworkers found out that the most important drawbacks with conventional cemented carbide were: • Quality, grain size and morphology of available tungsten carbide raw material

• Little possibility to control WC grain size during the manufacturing process

• More optimal sintering process for low binder phase cemented carbide

The larger WC grain size was needed especially both for improved thermal conductivity but also for increased toughness and reduced risk of crack formation during rock cutting. In several patents from around 2000 the new type of very large grained tungsten carbide and a new manufacturing route was presented by the team (around 50% larger tungsten carbide grain size compared to conventionally manufactured cemented carbide). The raw material supplier Wolfram Bergbau in Austria had developed a new high quality large grained tungsten carbide raw material with more rounded shape that was very successfully used in the new S grades introduced in the early 2000s mainly in mineral and ground tool applications. Similarly control of tungsten carbide grain size during manufacture and also improved manufacturing methods also used for top hammer and DTH grades and a new XT48 grade was introduced in the middle of the 2000s. Another 50% improvement in tool life were achieved for most hard rock mining and construction applications. At that time Fischer had already retired, in 2002. Hartzell continued to be the percussive drilling tool cemented carbide specialist within Sandvik for another 10 years and was also a very good mentor for young researchers joining the team until he retired in early 2011.

Åkerman moved, in 2000, to Zeltweg and joined the former Voest-Alpine team in Austria, at that time also another part of Sandvik Mining. There he, as the father of the Icutroc tool concept, is still the important tool specialist necessary for the further development of roadheaders and all new cutting machine concepts like box-hole borer, reef and borer miners.