ARIX – a major advance in diamond segment design

A Korean diamond toolmaker has succeeded in producing diamond segments with a completely even distribution of diamond particles within the bond. It is claimed that this has led to substantial improvements not just in blade life but also in the cutting speed at which the sawblade can be operated. Report by **H. Park**.

Conventional diamond segmented sawblade manufacture involves dry mixing diamond particles with metal powders, pressing and then heating to produce the finished segment which is then brazed onto the sawblade blank. The main drawback to this method is that the diamond particles are randomly distributed throughout the segment and each individual particle, therefore, is not subjected to the same cutting force throughout the cutting operation.

Where particles are too closely clustered, the leading particles do most of the 'work' whereas the following ones are not contributing fully to the cutting mechanism. This leads to premature pull-out of the leading particles. Similarly, where large gaps between particles exist, the bond is being exposed to the workpiece which leads to erosion of the bond. The overall effect on blade performance was lower tool lives and slower cutting speeds.

Ideally, diamond particles should be evenly distributed throughout the bond which means they are all subject to the same cutting forces and the segment is operating at its optimum efficiency. Up till now this has only been possible to achieve by using time consuming manual labour - a situation which is clearly unacceptable in mass production manufacture.

This situation has now changed though with a new development called ARIX – an automatic array system of segment manufacture from Korea based diamond toolmaker, Shinhan Diamond Industry Co Ltd (Fig 1). In December, 2004, Shinhan hosted a press conference at the Westin Chosun Hotel in Seoul to announce its new ARIX technology to invited journalists (Fig 2).

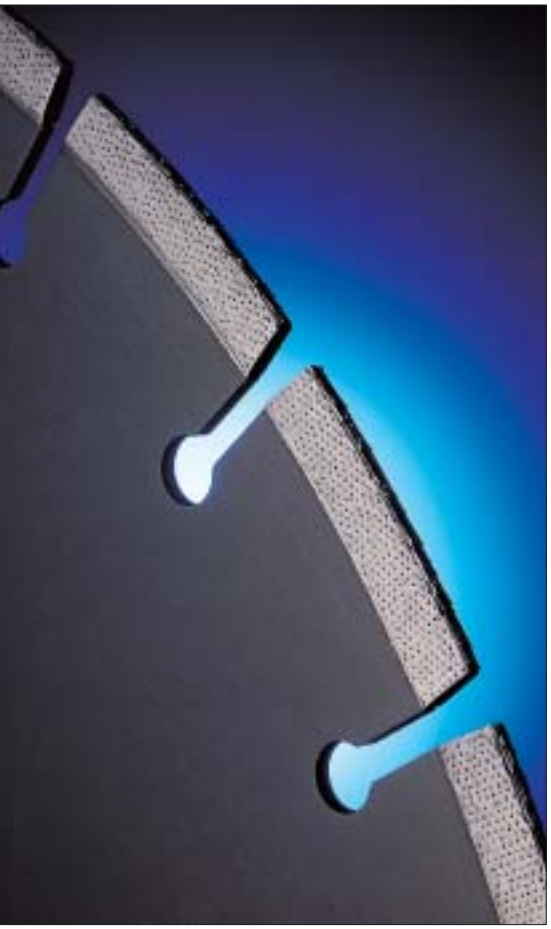
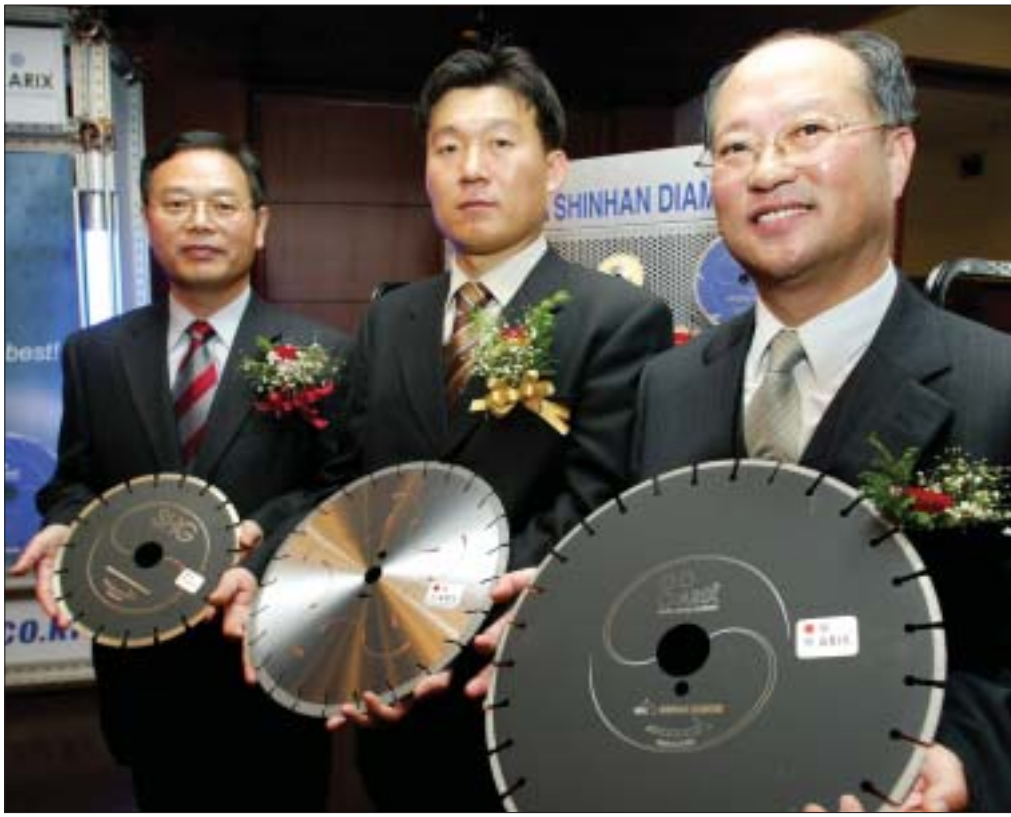


Fig 1 Close up of segment manufactured using ARIX technology shows the even distribution of diamond particles within the bond

Fig 2 XXXX, YYYY, and ZZZZ at the Shinhan press launch in December



Cutting speed vs. tool life

The concepts of cutting speed and tool life have always had an inverse relationship among conventional diamond tools. Increasing the cutting speed leads to a drop in tool life and vice versa. Many diamond tool manufacturers have tried to improve the performance of a diamond blade by revising the diamond particle distribution to counteract this relationship, since it is known that the cutting efficiency of diamond particles in the segment of the blade is dependant on the distribution of inter-particle distance. Up till now all have failed.

With ARIX technology, it is possible to maintain 100% control over inter-particle distance during segment manufacture. The result is that both tool life and cutting efficiency are enhanced significantly owing to the even distribution of diamond particles in the diamond segments.

The theory behind the ARIX technology is not new, in fact it was developed as long ago as the 1930s. Applying this to the diamond tool industry, however, was another thing, involving the placement of 30,000 to 40,000 fine sized diamonds (diameter between 0.1 mm to 0.2 mm) in an even distribution within the segment. Such a long and gruelling process of manufacturing was not easy to apply to diamond tool production.

Dr. Hyunwoo Lee, research leader of this confidential project stated that 10 researchers were engaged in what was known as Project 'A', the original name given to Shinhan's development of ARIX technology when it started in 2001. since that time, the company has spent 2 billion Korean Won (US$2 million) on the project. According to Dr. Lee, the company first succeeded in the developing the ARIX technology in June 2003, but productivity was not satisfactory. Afterwards steady and persistent efforts towards productivity enhancement were made till Shinhan finally arrived at its present position which involved the development of equipment capable of manufacturing 50,000 segments per month.

Even distribution

The president of Shinhan, Mr. Shinkyung Kim, said, "The utilization of ARIX technology, which allows diamond grits be evenly distributed among the metal powder of the bond in turn enables users to enjoy enhanced and uniform cutting efficiency." He also stated that ARIX technology applied tools have features which have improved cutting speed by 30% and extended tool life by 100% (Figs 3, 4 and 5).

Shinhan is also well known in the construction field in Korea through its wire saw products. Last year, for example Seoul municipal government initiated the demolition of overpasses of Cheonggyechon, a main highway which passes through the middle of Seoul downtown. Here, Shinhan's wire saw products showed their true worth, as the huge structures built with concrete and reinforced steel rods were cut and removed easily without excessive noise and dust.

With the introduction of this innovative technology, Shinhan forecasts that a great change will take place in the area of diamond tool manufacturing. The company expects its own share of what it says is a US$5 billion dollar market to rise to the 10% level from its present 2% level within 5 years. Most of this increase will be the result of inroads made into the market by the expansion of segments manufactured by the ARIX auto-array system.

Considering itself as a medium sized enterprise, last year, Shinhan sold a total of 120 billion Korean Won (US$120 million) in diamond tools with 60% of the sales coming from overseas. A significant statistic is the 5 billion Korean Won (US$5 million) the company spends each year on R&D purpose, a much higher proportion than similar sized companies within the industry and a demonstration on its commitment to growth and development. ◆

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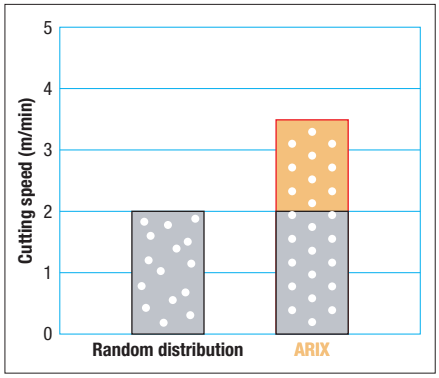

Fig 3 Comparison of cutting speed for ARIX vs. conventional segments

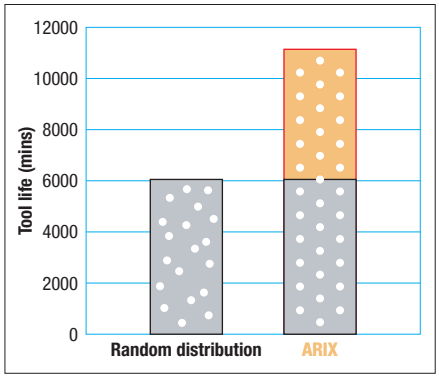

Fig 4 Comparison of tool life for ARIX vs. conventional segments

Fig 5 Tests showed that cutting with an ARIX segmented blade was faster and more efficient than conventional segmented blades