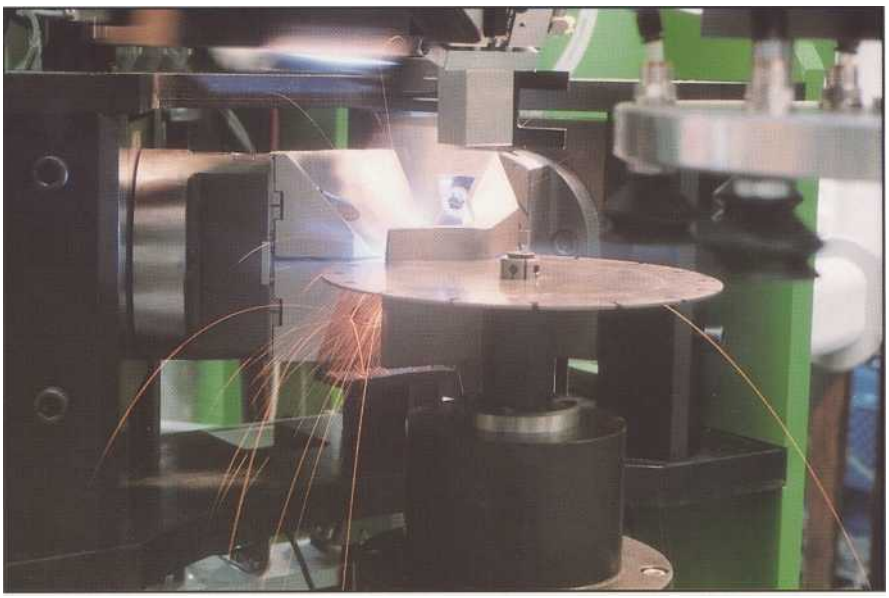
New laser welding machine for diamond saw blade manufacture

The market for small diameter diamond blades for the dry cutting of construction materials has developed rapidly in recent years. With the LSM 240 laser welding machine, Dr Fritsch Sondermaschinen GmbH has now developed a system capable of the fully automatic and economic manufacture of such blades in the size range from 100 mm to 450 mm in diameter. Report by **G. Weber** and **S. Burckhardt.**



Fully automatic segment welding

Diamond circular saw blades are being used increasingly in the construction industry for carrying out supplementary cutting operations on a very wide variety of building materials, particularly for cutting openings once the shell of the building has been constructed. Especially when working indoors, it is important to avoid damage to walls, and the cutting must therefore be carried out without the use of cooling water. Consequently, most blades and saws have been developed for dry cutting.

However, European suppliers operating within this sector of the market have found themselves facing increasing competition from Far Eastern suppliers, particularly where small diameter blades for use on hand-held machines are concerned. Because of the local conditions in Europe, such as the relatively higher wage costs, this competitive pressure can be counteracted only by employing more efficient production methods to manufacture the product in the largest possible batch quantities.

Against this background, the demands made on the machines for manufacturing diamond segments are also being redefined. Fully automatic operation, high-efficiency manufacture and ease-of-use are essential if modern production machines are to achieve optimum economic performance. Now that the segment manufacturing stages of cold pressing and sintering have been successfully automated, there is a need to bring the subsequent stages of production into line as well.

Brazing or welding?

In general, either brazing or welding may be used in the manufacture of diamond blades. Brazing is well established, particularly for the manufacture of blades for the natural stone industry. Because of the relatively short time required - approximately 5 seconds, compared with the approximately 20 seconds it takes to braze a segment - laser welding's speed makes it particularly suitable for the economic production of dry cutting blades. However, when this method is used it is not possible to re-tip the blade with a new segment, because of the strong bond between the segment and the blade centre.

These differences between the two methods result in different strategies being adopted in different regions, and therefore enable different market requirements to be identified. In the USA, for example, for reasons of safety and reliability in the manufacture of diamond blades, laser welding is preferred. It is not the intention to re-tip the blades because of the great distances involved. In Europe, on the other hand, re-tipping is (still) an economic proposition, which also explains why, until now, there has been limited demand for dry cutting blades.

Because of the high temperatures involved, the segments used in laser welding must have a diamond-free

The LSM 240 laser welding machine

base. Such segments are made up of different materials, with the part of the segment in contact with the blade centre containing no diamond. Laser welding is very demanding as far as segment geometry is concerned and requires the use of precision sintering machines. Also, not all bond types are suitable for use with laser welding; bond formulations containing tin, for example, are not recommended if this method is used.

LSM 240 fully automatic laser welding machine

Dr Fritsch Sondermaschinen GmbH, Fellbach, Germany, supplies a range of raw materials, machines and other equipment for use in diamond tool manufacture. With the LSM 240, the company has now introduced to the market a fully automatic CNC laser welding machine for the manufacture of diamond saw blades in the size range from 100 mm to 450 mm in diameter.

The complete system consists of five sections, of which the machine itself and the laser are the most important elements.

In the machine section, the blade centre magazines are located on both sides of the welded frame structure. In the middle, between the two magazines, is the holding fixture for the saw blades, which are taken from a linear table with an in-built turning mechanism. The segments are fed in automatically by means of spiral and linear conveyors. The in-built welding station, along with the pneumatic blade centre and segment clamping fixtures, ensures precise positioning of the two components of the saw blade. The laser head, with its inverted, water-cooled lens system, is moved by two CNC axes and can move along all the normal radial paths, as well as in straight lines.

The modern 2000 W CO_2 compact laser, manufactured by Rofin-Sinar, is characterised by its precision and low gas consumption. The main feature of the LSM 240 is its modular construction, which enables the machine to be connected to a laser from any manufacturer which may already be in place.

Method of operation

The blade changing device takes a blank blade centre from the magazine and places it in the work-holding fixture on the rotary table. The table, with the blade centre, is transported from the linear table to the welding station, where the blade centre is measured, orientated and clamped in place pneumatically. The first segment is brought up, positioned and also fixed in place. After the laser has been fired, the lens system travels at a rate of up to 2.5 m/min along a path and radius set depending on the diameter of the blade centre. At this speed the width of the laser beam is 0.2 mm. A wider melt joint can be obtained by reducing the speed of travel. When the welding process is completed, both the blade centre and segment clamping fixtures are opened, the blade is indexed and another segment is placed into position. This procedure is repeated until all the segments have been welded to the blade.

Blade centres up to 3 mm thick are firmly attached to the segment after just the one welding operation. With thicker blades, however, the blade has to be turned over and the segment welded for a second time on the reverse.

Economics

Because of the use of a laser, the laser welding technique involves a much higher level of investment than that required for brazing. However, the short process time involved ensures that such machines have an economic advantage over brazing in precisely this field - the mass production of dry cutting blades. For example, a 230 mm diameter saw blade fitted with 16 segments can be completed in approximately one minute.

Also, not too widely known is the fact that, by using a laser divider, one laser can be made to serve two stations at the same time, thus doubling throughput. Because of the higher generator capacity, brazing units are not capable of providing such an increase in throughput. With the use of modern lasers with a power in excess of 2000 W, increases in throughput can be expected similarly in the future.

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