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Advantages Ofered by Mechanised Cold Bevelling

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There are various process options for bevelling such as oxy fuel bevelling, nibbling, grinding, shearing and milling. In this study, Rajiv Deshkukh provides insights on the various bevelling process options and their comparative advantages and disadvantages.

Plate edge bevelling is one of the very important processes in the metal fabrication industry. For a better quality fabrication, welding plays vital role, and the correct and accurate bevelling is the first step towards obtaining the best welds.

There are various process options for bevelling such as oxy fuel bevelling, nibbling, grinding, shearing and milling. The first process is thermal process and usually creates heat affected zone (HAZ). Therefore, depending on weld joint serviceability and the material composition, it is cautiously used. However, its use is now tapering down due to other factors such as productivity, limited accuracy and higher indirect costs.

Most commonly used bevelling options are shearing and milling processes from thermal processes. There are three types of bevellers available - hand held, table top models and automatic ones.

For hand held and bench mounted types, milling process is the most preferred one as it offers ease of operation and economy. These are good for profile bevels, smaller jobs and radius bevels too. These come handy for small size pipe bevels also.

For large plate bevels, shearing and milling are used. However, the latest trend is to use milling process as it offers distinct cost benefits, gives best smooth bevelled surface without any marks, dead accurate bevel angles and consistent root force, besides big range of continuously variable bevel angles.

The milling types bevellers are preferred since these can be used on practically all the materials including weldox/hardox, SS, low and high alloys including super alloys like inconel, hastalloy and even armoured steels, aluminium and range of carbon steels.

However, milling and shearing processes have their own advantages and limitations. These are to be considered based on the mechanical properties of the material to be bevelled, the bevel angles needed and the bevelling environ-ment, also, the bevelling speeds based on the material composition. The economic conside-rations in terms of cost of the tool plays important role in the selection of either of these processes.

Milling inserts are quite effective bevelling tools at a reasonable price. In this type, only inserts need to be changed which works cut to be quite economical. However, in the shearing type of machines, the complete cutter needs to be changed which works out to be very expensive as far as running cost is concerned; additionally inventory cost also goes up considerably.

Ways in which cold bevelling can help

Automatic cold bevelling process offers some very important benefits.

Elimination of HAZ ensures the weld joint strength since the micro structure remains unchanged around bevelled edge. The cold bevelling eliminates the head input and consequently thermal stresses and improves the weldability. Accurate bevel angles ensure optimum weld metal deposition. Reduced heat input ensures minimum distortion. Further, it saves on weld metal deposition as every degree increases in the bevel angle, increases the molters metal deposition by about 12-20 per cent. This not only increases the direct costs for welding consumables but also adds up indirect fixed and variable costs.

Accurate and consistent root face over the entire length of bevel takes care of the correct fit-ups most important for automated welding, which needs to have consistent root gap and no mismatch. The success of welding automation largely depends upon the joint fit-ups.

Smoothbevelled surface avoids possiblke contamination on the surface to be fused, thereby avoiding the foreign particle entropment causing the typical weld defects. This also ensures uniform and homogeneous deposition giving good side wall fusion and eliminating the hair line cracks and allied defects.

These automatic bevelling machines are very easy to operate and eliminates huma skills, It also reduces skilled manpower cost. However, speed and finish play important roles in making a choice of shearing or milling process. One can get higher speeds by using shearing process but the costs are very high. Shearing is generally used effectively for plate thickness upto 40 mm in multiple passess. Beyond these, milling certainly is a cost effective method.

The factor of cost

A typical example based on computation of all direct working costs, like tool cost and power cost on a specific type of material for milling process shows the approximate bevelling cost per meter is about Rs.15 to Rs. 25 per m, going from low tensile to high tensile materials. Higher the tensile, higher the cost. Also higher the thickness, higher the cost but comparatively less than shearing process.

This is the reason that for higher thickness, milling type bevellers are better; offering benefits of optimum speed and cost. The sheering machines also run a risk of higher maiantenance cost due to the possibility of breaking of cutter or else of bevel gear/gear box. Compared to the milling machines, the shearing machine cost per meter of bevel will be 15 per cent higher.

Above guidelines are to be kept in mind for selecting the correct beveller for a specific job. The important factors are quality, speed, operating cost, maintenance cost and tensile strength of material and lastly, the variety of bevel angles involved.

In conclusion, milling machines are more cost effective over wide range of materials and thickness as against shearing machines, which work better in the limited range of thickness and are generally good up to mild level tensile strength plates.

Points of comparision between thermal and cold mechanised bevelling using milling process

Applicability

a) Thermal process (oxy fuel cutting) - This process is not suitable for special alloys, high tensile steels and other thermal sensitive materials, as it will create on HAZ which changes the grain structure. Therefore, applying thermal bevelling has to be done very carefully and selectively.

b) Mechanical bevelling - The automated cold bevelling process by milling is suitable for almost all materials including high tensile steels, super alloys, titanium and other sensitive materials as well. It does not alter metallurgy of the parent material and therefore its safe.

Range of bevel angles

a) Thermal process - It is best suited for angles upto 45°. In angles < 45°, there are always chances of reduction in accuracy and hence the total included angle may increase resulting in extra weld material in the joint, further resulting in extra welding consumable, power, manpower and other costs like grinding wheels, gases etc.

b) Mechanical bevelling - This process is suitable from 0° upto 80° and in some cases more. Therefore, it can cover practically an entire range of recommended bevelling angles,. Automated bevelling using milling process can be usedstarting from 5 mm to 200 mm, although the general range is 8 to 100 mm. By extending the bevel angle range upto 90°, the automatic bevelling by milling process offers the decladding option. It can be very useful for large and thick cladded plates, used in heavy fabrication for cricical and super critical applications such as reactor vessels, heavy machine building, super critical thermal power and atomic power stations, armoured vehicles. etc.

It offers very accurate bevel angles, consistent root face (land) and mirror finished smooth bevelled surface. Therefore, the joint fit ups avoid gaps and mismatches, and such fit ups are best for automated welding. Extra and unwarranted costs of welding consumables and other costs are eliminated thereby making it cost effective.

Bevel Speed

a) Thermal process - Spreads are limited as any increase in speeds beyond a recommended speed will affect the quality of bevel. It will also need extra heat input which will be determental to the plate being beveled. creating a bigger HAZ.

b) Mechanised bevelling - This is a high speed bevel process. This does not get restricted by manual operator skills or any other factors.

The bevel speed remains consistent and can be adjusted for optimum output depending on the material being bevelled. Usually, maximum speeds upto 2.6 to 3m/min can be obtained depending upon the bevel process chosen.

Cost of Belling

a) Thermal process - Basic cutting cost constitutes of manpower, gases, grinding wheels, cutting nozzles, grinding, two operators (one each for grinding and cutting), accuracy of angle, indirect costs of extra weldment, extra consumables, gas etc.

b) Mechanical bevelling - Direct costs of inserts and nominal cost of power are involved. Most indirect costs due to factors as explained in thermal bevelling are avoided. Therefore, it's on economical process. The cutting costs by this method compared to thermal cutting are lower by about 15-40 per cent depending on various operating factors already explained.

Productivity

Considering the factors started above, the productivity of thermal bevelling is lower compared to mechanised bevelling by 20 - 45 per cent, based on all the operating factors. Therefore, mechanised bevelling is the preferred option.

Conclusion

Cold mechanised bevelling is faster, cleaner, reliable and an easy-to-handle process compared to thermal bevelling. Cold mechanised bevelling therefore is considered the most acceptable process for ensuring higher productivity and improved quality at an optimum cost. In cold bevelling processes, shearing and milling are the options and milling is a better option for quality, workability over a wide range of materials, higher thickness, wider choice of continuously variable bevel angles (0° - 80°) and choice of bevelling for all types of bevel preps including J bevels.