Around the pipe in 80 seconds

Magnetism stops welding. Then the old 'black magic' begins. John Anderson reviews the causes and some solutions without recourse to witch doctors.

Magnetic arc blow causes welding job delays, poor weld quality, welder frustration and unexpected costs – particularly frustrating when everything is in place yet the project is completely stalled (Fig. 1). Now we get to the point where 'black magic' is invoked to make the magnetism disappear: heat it up, hit it with a hammer, trail the weld set cables over it ... wait till the sun goes down?

Like most old wives' tales, there is often a spark of truth in there somewhere. For example if you could heat the whole pipe to the Curie point temperature (~600C) then the magnetism would be removed. However, so much of such lore does not have any real practical validity and the magnetism problem needs to be addressed with proper engineering rigour. There are several solutions to the arc blow problem and here we identify the advantages and disadvantages of each.

Field nulling

The first method is to use an automatic or manual nulling method. The idea here is to induce a reverse field in the pipe (or other steel part to be welded) so that the net field is zero. With this in place welding can take place as if there were no magnetism gremlins at all. When the welding is completed, the reversing field can be removed and magnetism in the pipe returns – but this is now of no consequence. This patented technique was developed over 10 years ago in conjunction with a national welding institute and the resulting demagnetiser, Zeromag ZM100A is now made by Diverse in the UK. The technique can be fast to deploy and the result is effectively instantaneous. The demagnetiser is designed specifically for this application, and can operate in one of two ways, manual or automatic: the choice is determined by the cause of the magnetism.

The variety of possible causes of the magnetism result in some complexity with this approach. If the magnetism has for example, been induced end to end by the earth's field, then the field emanating from the pipe end surface will be homogenous and the field can be easily nulled all around the circumference with a single manual setting. Alternatively, if the magnetism has been induced by industrial processing such as NDT, magnetic lifting or pigging, then the field at the end of the pipe will not be homogenous and the reverse nulling field will need to change dynamically in magnitude and sign as the welding progresses. This is accomplished with the demagnetiser in automatic mode.

Degaussing

Classic degaussing is another approach to this problem. The technique removes the magnetic field by down cycling which excites the magnetic field to a very high positive value then progressively decreases the magnitude of the field to zero while alternating its sign – a process called down cycling (Fig. 2). The result is that through this wizardry, all the magnetism is removed!

This approach has several practical problems. It can be slow taking hours or even days to do the job. Worse it may not be effective at all if the strength of the degaussing field is too low (below the saturation

Fig. 1. Arc blow problems can causing severe project delays.

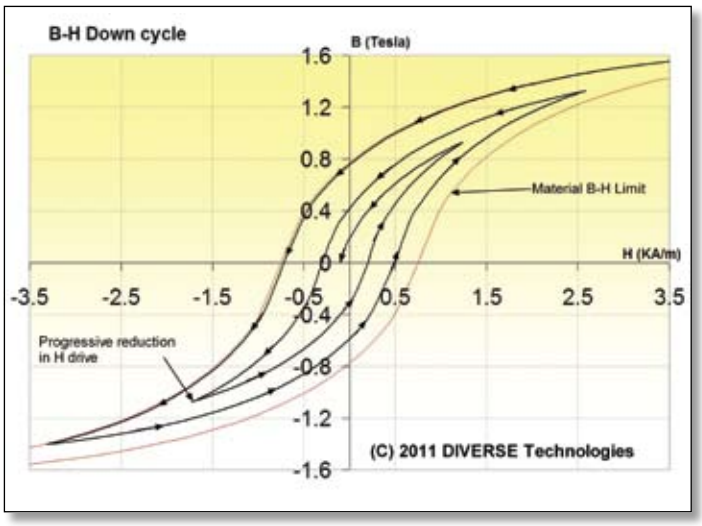

Fig. 2. Classic degaussing removes the magnetic field by down cycling.

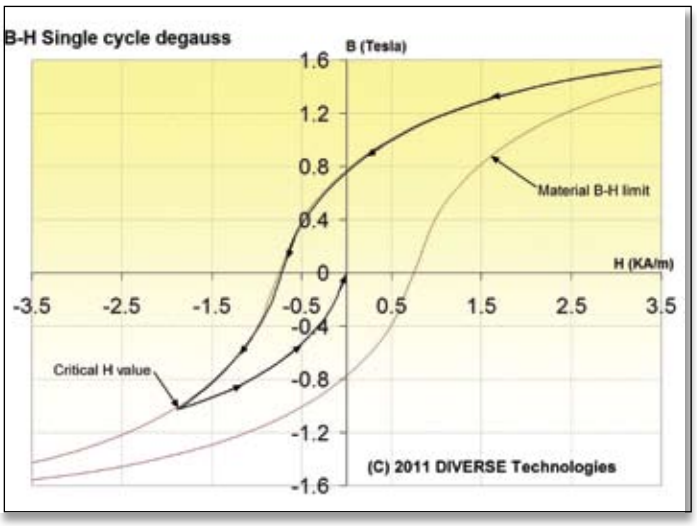

Fig. 3. Magnetic removal performance is similar to the down cycle method.

magnetisation of the material). The high field requires high currents and over the time to degauss this is energy intensive. Penetration depth into the steel when running at line frequency of 50/60Hz is insufficient to degauss thick walled pipes completely.

The solution is to use a degaussing system with high current and relatively low frequency of operation. Since in practice it is the ends of the pipe where the welding is to take place, it is only here that the magnetism needs to be removed. Consequently a degaussing scheme working at high current and low frequency over just the end of the pipe, will provide a solution. The Zeromag demagnetiser can be used with the ZM150 degauss controller to provide this function. Pipe end degauss usually takes 3-5 minutes.

Unfortunately, although the field is significantly reduced by this method, the rest of the pipe will still be magnetised and that magnetism will, like some magic spell, slowly creep back into the material at the end of the pipe. The time taken for this is typically 1-2 hours. This therefore gives a time horizon for this process - both pipe ends and at the very least the root pass must be completed before the bad black witch of magnetism returns. Although this may seem to be inappropriate for some applications, it is used in production scenarios, for example spool base or lay barge where the production rate is high and the weld time is short.

The above discussion suggests that it would be good to be able to degauss quickly and, if necessary, degauss again mid-job if the magnetism returns. To speed the process, the degauss controller can be configured to use a novel single cycle demagnetising scheme. The idea is to identify a critical point in the B-H characteristic of the material, which, when the demagnetising current is returned to zero, the remnant magnetic field also returns to zero- (Fig. 3). The magnetic removal performance is similar to the down cycle method. Using this technique, the pipe end can be degaussed in a single cycle taking less than 80 seconds. When this is combined with clam coils, which allow the demagnetising cable to be deployed in a few seconds, a highly efficient methodology unfolds. The process is as follows:

1. Fit up the butt joint.
2. Check the field in the weld prep.
3. Apply the clam coils.
4. Undertake a single loop demagnetisation of the joint.
5. Remove the clam coil, check field in the weld prep.
6. Weld.
7. If the magnetism returns, then repeat the demagnetising process as required.

This method is fast! In fact so fast there is virtually no impact on job completion times, no matter what the level of magnetism. If your material or job geometry preclude this method, you can always fall back to magnetic field nulling.

Summary

The arc blow problem can cast a spell over a project causing severe project delays, so having the right demagnetising equipment available is seen by many leading fabricators as very good insurance, especially when the cost of delay is high. Using one of the active nulling or degaussing methodologies described can get a project going at full speed again without the need for magic wands. Abracadabra! ●

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