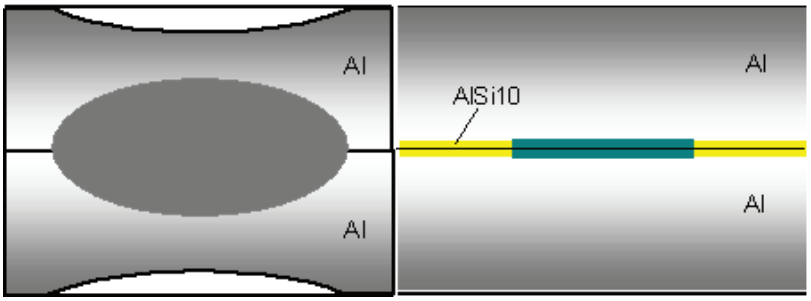
Resistance spot brazing of aluminium

The alternative to spot-welding



Schematische Darstellung, links: Punktschweißung, rechts: Al-Punktlötung

Situation of aluminium welding

As is known, the difficulties associated with resistance spot welding of thin aluminium sheets are much greater than in the resistance welding of steel. Aluminium's very good conductivity and the rapid diffusion of copper in aluminium are particularly inconvenient for the process. These are the reasons, because in comparison with steel essential higher currents (factor 3) are necessary and electrode life is very low (200 ... 300 spots). For producing high quality joints it is necessary to use a current-force-program.The high melting oxide film on the surface impedes the joining process and leads to increased electrode wear.

Recently it has become possible to produce lap joints with sheet surfaces almost unaffected on one side by projection welding since DC welding machines are fitted with a special pneumatic system. This is a major technical advance. Altogether however the technical complexity of the whole plant technology used at present for the resistance welding of aluminium is large in comparison with steel. Owing to the difficulties in welding aluminium, there is a tendency to prefer mechanical joining methods for lap joints.

Besides its high equipment cost, laser beam welding of aluminium also has special features compared with steel which are usually associated with technical disadvantages. MIG pulsed-arc welding of aluminium is relatively seldom used, because of considerable demands on the training level of the welder. All in all, although its productivity is relatively low, TIG welding is used to an extent representing a high average for the processing of thin aluminium sheets, because of the disadvantages of the other welding processes.

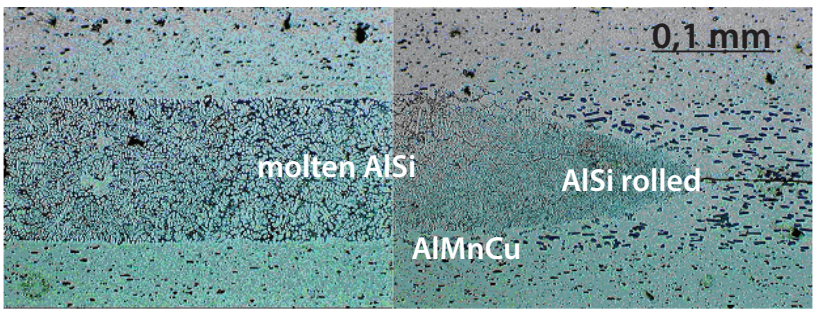
Potential of previous brazing processes

Many disadvantages of welding can be avoided by use of brazing processes. AlSi alloys are preferably used as the brazing metal. A problem of previous brazing methods, however, is that the work must be carried out with fluxes, under vacuum or under a shielding gas.

Aims

To extend range of application of the brazing process, the following aims were set within the development project:

- Produce joints of thin aluminium sheets in the thickness range 1 to 2,5 mm.
- No use of flux.
- Use of simple and economical spot welding machines, and of course,
- less surface damage.



Spot brazed joint, micrograph

Prerequisite

The prerequisite for application of the new technology is the availability of braze-clad thin aluminium sheets. These materials are offered by a number of suppliers. The cladding alloys are AlSi, with a layer thickness (on one or both sides) of about 60 to 100 µm. This solves the problem of braze deposits that otherwise occurs.

The brazing alloys used are AlSi7.5, AlSi10 or AlSi12, with melting ranges of 577-605 °C, 577-591 °C and 577-605 °C respectively. Until now for commercial operations the "core alloys" (basis materials) have always been alloys of the 3xxx series or unalloyed aluminium, because of their relatively high solidus temperature (>610 °C). Some alloys in the 5xxx and 6xxx series also have sufficiently high solidus temperatures, so extension of the technology to these alloys seems possible as well.

Equipment

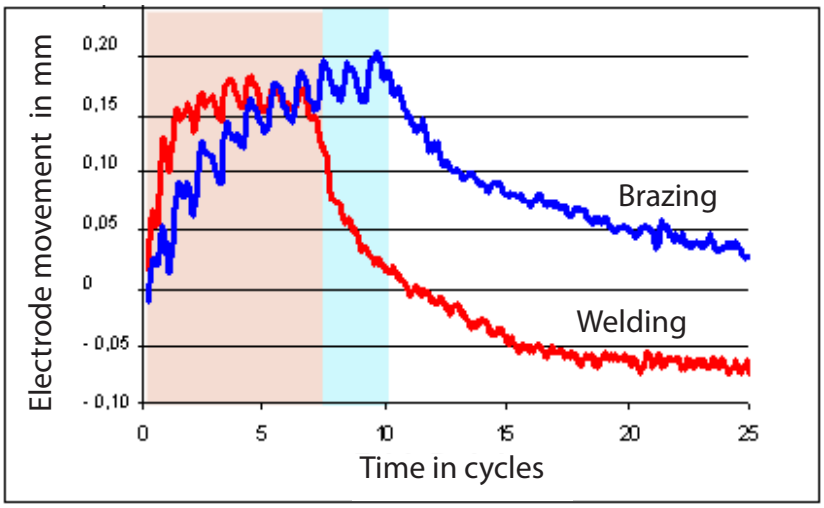
The brazing process is carried out using normal spot welding machines (AC machines without current and force program) in a time corresponding to that for spot welding. Very good joints are achieved. The use of roller seam welding machines enables to produce linear joints as well. Joints produced in this way showed very good results.

Advantages

The advantages are as follows:

- Simple spot welding machines with no force program are also suitable.
- Nearly no surface deformation.
- Process time is the same as for spot welding.
- Facilitated melting process by a brazing alloy with high specific resistance and low melting range.
- More gentle and shorter electrode movement than in spot welding (see graph), and therefore higher process stability.
- Clearly smaller mechanical and metallurgical notches, giving an expectation of improved fatigue strength.

Process specific electrode movement



The technology was developed in the context with a project promoted by the Federal Ministry for Economy.

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