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MODULE N

Electric arc welding under flux



Electric arc welding under flux

- ▶ Submerged arc welding is substantially arc which burns between the bare electrode of unlimited length and materials to be welded under a protective layer of flux.
- ▶ It they are mostly automated method.
- ▶ Method of arc welding under flux is compared with manual welding, coated electrode, if necessary. TIG welding or MIG / MAG performs much better, i.e. melted for about two to five times more metal electrodes.



Benefits

- Great penetration into the base material,
- High current density even with thin welding wires,
- Improved quality welds.
- Fillet welds able to reduce by 25% in comparison with welding ROE.



Drawbacks

- Increased demands on the joint preparation and their purity, wide heat-affected zone (sometimes is an advantage), hidden welding process and the difficulty of its control.
- Only the possibility of welding in positions PA and PB according to EN ISO6947.
- Difficult removal of slag in multilayer welds especially welding into a narrow gap.

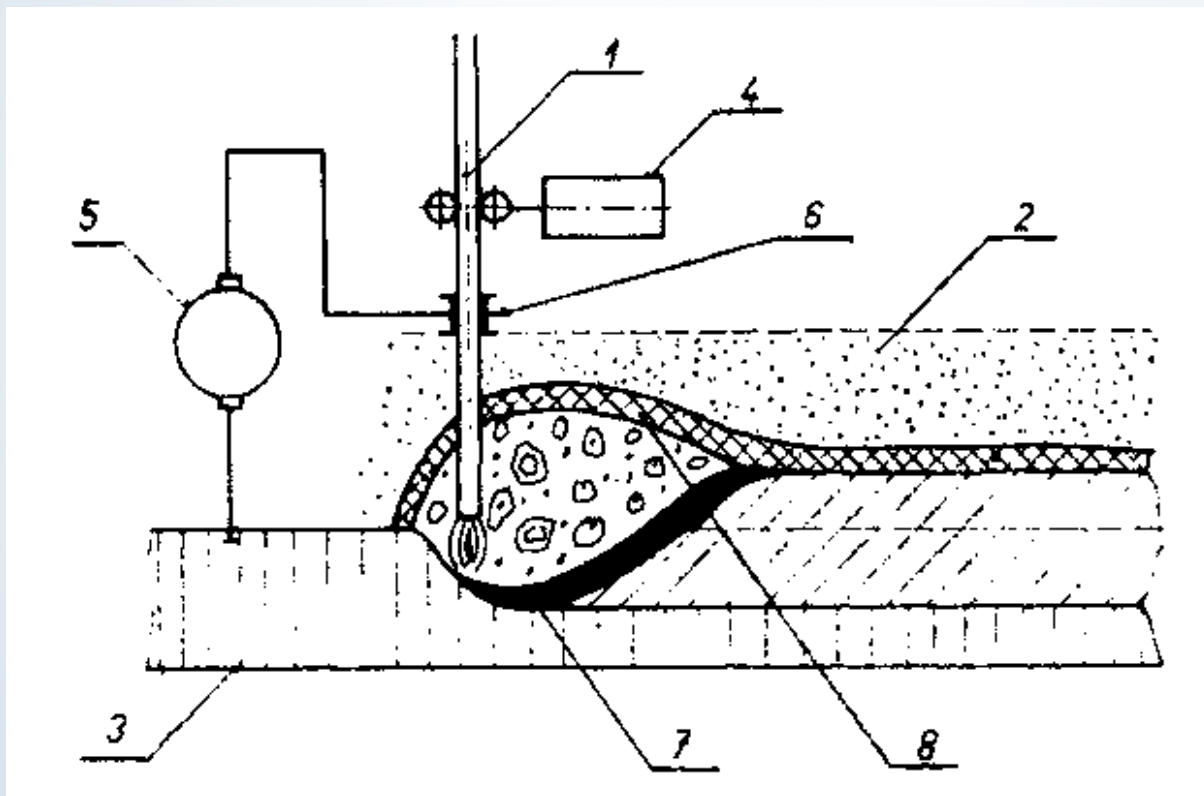


Characteristics of submerged arc welding

- ▶ Economic minimum weld length: 1000 mm above (for materials of large thickness less)
- ▶ Material thickness: 3 mm to 100 mm or more;
- ▶ Welding current of 200 A to 2000 A,
- ▶ Arc voltage 20 V to 50 V,
- ▶ Welding speed: 15 m / h to 120 m / h,
- ▶ Current type: AC and DC,
- ▶ Diameter of the auxiliary material (wire): 2.0 mm to 8.0 mm.



Principle of submerged arc welding



- 1 - welding wire;
- 2 - flux;
- 3 - welded material;
- 4 - wire feeder;
- 5 - power supply;
- 6 - contact;
- 7 - the molten weld metal;
- 8 - slag

AMBROŽ, O. A KOL. *Technologie svařování a zařízení: učební texty pro kurzy svářečských inženýrů a technologů*. Ostrava: ZEROSS, 2001. s. 210.



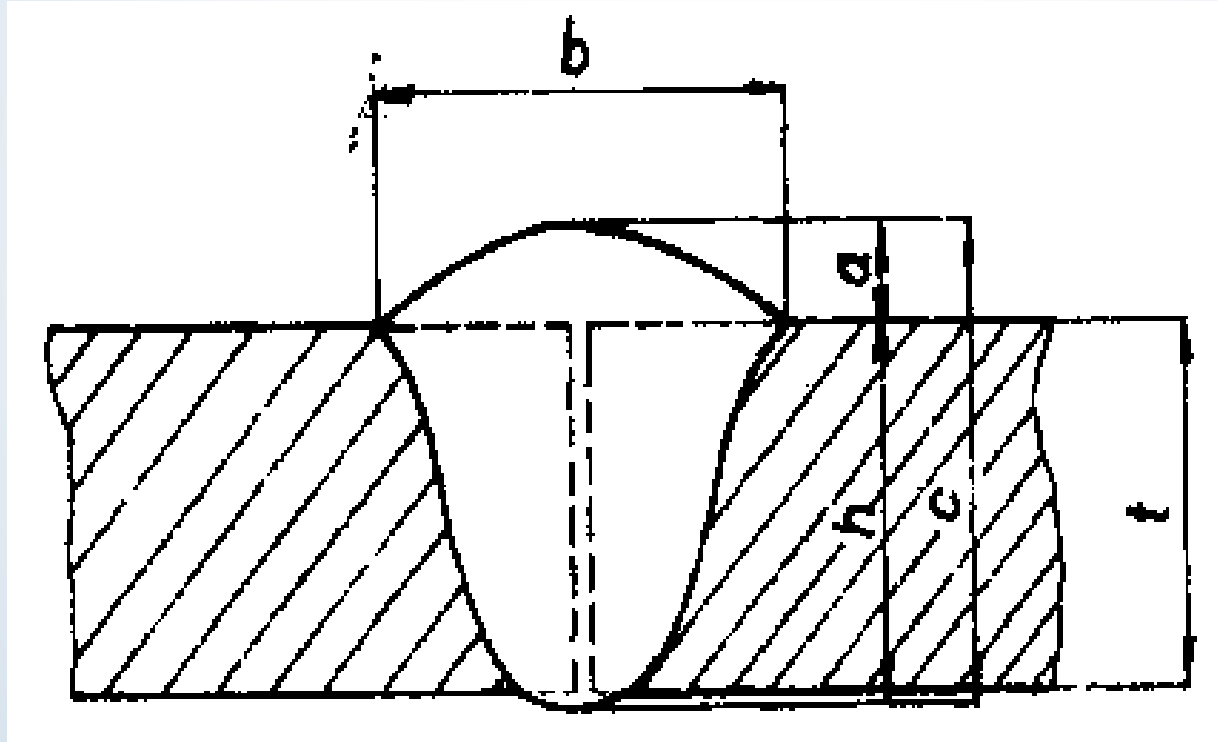
Technological parameters submerged arc welding

- ▶ Technological parameters submerged arc welding significantly influence the shape of weld bead cross section.



The characteristic dimensions of the weld

► Form factor of the weld is b / h



B - width of the weld,
 a - excess weld
 h - penetration depth, $c = h + a$
 t - overall height of bead



The characteristic dimensions of the weld

- Mechanical properties, structure and chemical composition of the weld metal is largely dependent on weld shape coefficient b / h .
- Main influence on the dimensions and shape of the weld has the amount of heat released in the arc, which is a function of welding current, welding voltage and welding speed.



The main welding parameters

- Welding current I [A]
- Arc voltage U [V]
- Welding speed v_s [M / h].



Side welding parameters

- Welding wire diameter [mm]
- Electrodes inclination [°]
- Inclination of the base material [°]
- Projection welding wire [mm]
- Character welding current and polarity.
- Characteristics of the flux.

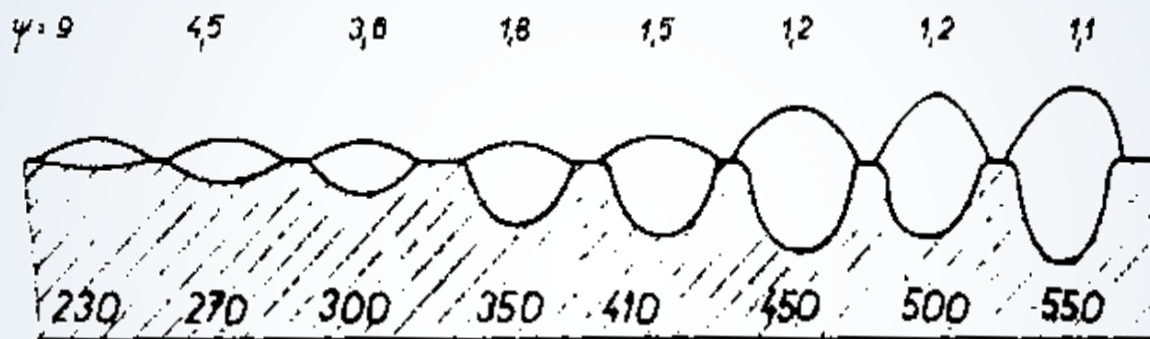


Influence of welding current I [A]

- The intensity of welding current is directly dependent on the amount of molten metal.
- Its increase, while maintaining the other conditions, current density is increased and heat concentration in a column of the arc.
- Simultaneously It increases the dynamic effect of the electric arc, so penetration deeper into the welding material and the weld shape coefficient is smaller.
- Individually the weld depending on the intensity of the welding current increases are as follows:



Reshaping the weld depending on the improvement of welding current



- ▶ increasing amperage has an influence on the melting of additional material.
- ▶ with increasing the current intensity increases cant bead while the bead width remains practically the same as the increasing intensity of the welding current is not changed.
- ▶ Depth penetration is therefore directly proportional to the welding current.

AMBROŽ, O. A KOL. *Technologie svařování a zařízení: učební texty pro kurzy svářečských inženýrů a technologů*. Ostrava: ZEROSS, 2001. s. 225.

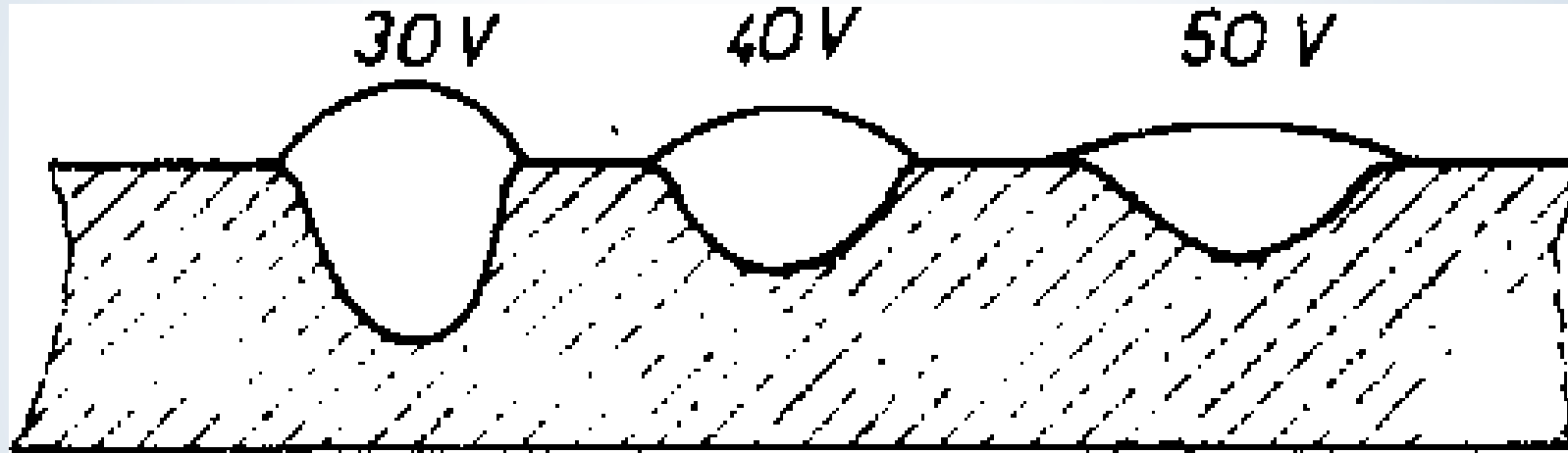


Effect of the welding voltage U [V]

- ▶ The arc column is extended with how the voltage is increased, because the heat which is formed in an arc heats a larger area of the welded material, and therefore reduces throughput of depth and width of the bead increases.
- ▶ Welding voltage is practically determined depending on the size of the welding current always to achieve a satisfactory weld shape coefficient.



The influence of the voltage change to form a weld



KUBÍČEK, J. DANĚK, L. KANDUŠ, B. *Technologie svařování a zařízení. Učební texty pro kurzy svařovacích inženýrů a technologů.* Plzeň: ŠKODA WELDING, s. r. o., 2011. s. 115.



Effect of welding speed vs [M / h]

- ▶ Welding speed is called progressive rate of formation of the weld bead.
- ▶ At constant welding voltage and the welding current with the changing speed of welding varies the amount of heat developed in the arc per unit weld length.
- ▶ Change welding speed also acts to change the direction of the arc and the distribution of the dynamic forces in the arc (a vertical and horizontal component).



Effect of welding speed vs [M / h]

- At very low welding speed (up to 10 m / h), the electric arc burns almost vertically, because the horizontal component of the dynamic force which is the most extruded molten metal from beneath the arc is negligible, and therefore melting of the base material is large (rising).
- Another increasing the welding speed starts to tilt the arc column and begin to cause dynamic force component of the arc so that the reduced melting of the base material and increases the weld overlay.
- When the limit (high) speed welding can occur lack of penetration the sides of the bead and the welding process will be very unstable.



Power sources for submerged arc welding

- ▶ They are sources of DC and AC mostly flat characteristic.
- ▶ Transformers they are suitable for neutral and acid flux or Multi-wire welding equipment.
- ▶ For basic flux is preferable direct current positive pole of the electrode.
- ▶ Because whereas the arc length during the welding (e.g. due to unevenness) change, it is necessary to regulate the welding process in order to eliminate fluctuations in the arc length.



ways regulation

- Regulation of surface characteristics of the power source (ie. self-)
- Regulation by Ward - Leonard sets.
- Automatic electronic control,
- Control magnetic amplifier.



Draft weldment

- ▶ The shape and type of weld joint determines material thickness, indicatively can use the standard CSN EN 29,692th
- ▶ Toupee joints up to 15 mm thickness can be welded on one side, in the thicker it must be welded from both sides.
- ▶ For welded large thickness is used in the narrow gap welding, which is particularly advantageous because it considerably reduces the time of welding, the filler material reduces consumption and reduce stress and deformation of the workpiece.
- ▶ For capturing the bulk of the flux at the start of welding the molten weld metal and flux during it is used several types washers.



types shims if necessary. structural arrangement:

- Welding copper or ceramic backing,
- Welding technology or a steel backing,
- Welding flux backing,
- Welding on the lock,
- Welding with hand-founded root.



Welding consumables

- ▶ To consumables for submerged arc welding calculate both the electrodes and flux.
- ▶ The electrodes are in the form of wires (typically having a diameter 2 mm to 5 mm, for the connecting welds alloy and fine grain steels EN 756) cored wires (for stainless or hard surfacing EN 12073) or tapes (for stainless surfacing EN 12072) or filled tapes for hard surfacing .
- ▶ Because the fact that the range of standard wire for submerged arc welding (especially for welding alloy steel) is inadequate and insufficient to meet the needs of industry, producing a series of wires that are not normalized.



Flux

- ▶ Listed CSN EN 760th
- ▶ According to the purpose can be divided into flux
 - ▶ Neutral
 - ▶ Active
 - ▶ Alloying



Flux

- Neutral
 - They are designed for multi-layer welding without thickness limit with appropriate types of wires.
 - Alloying elements, preferably Si Mn They are strictly limited so that the chemical composition of the weld metal was the same in all layers.
- Active
 - Supply into the weld metal as a major proportion of Si desoxidant and Mn as an alloying element.
 - Used primarily for single-layer welds,
- Alloying
 - Supply to weld metal alloy (C, Cr, Si Mn et al.), when used in combination with unalloyed wires.



Dividing flux production by

- Melt - produced in electric arc furnaces (flux suitable for mild steel)
- Agglomerated (ceramic) - made from powder components and bonded water glass. The flux in a particular chemical composition for alloy materials suitable for welding and,
- Sintered- powder sintered component under pressure. Suitable for alloyed materials and for welding into a narrow taper because of the good slag removability.



Dividing flux by chemical composition

- Manganese - silicate (MS), zirconium - silicate (WT), rutile - silicate (RS), calcium - silicate (CS) and aluminate - silicate (AS)
- Alumina - basic (AB) aluminate - fluoride - basic (AF) and aluminate - rutile (AR)
- Fluoride - basic (FB)
- Grain size of flux ranges between 0.25 mm - 2.5 mm.
- First of all, agglomerated (ceramic) and sintered flux is hygroscopic and must be dried before use - 2 throw. at 300 ° C.

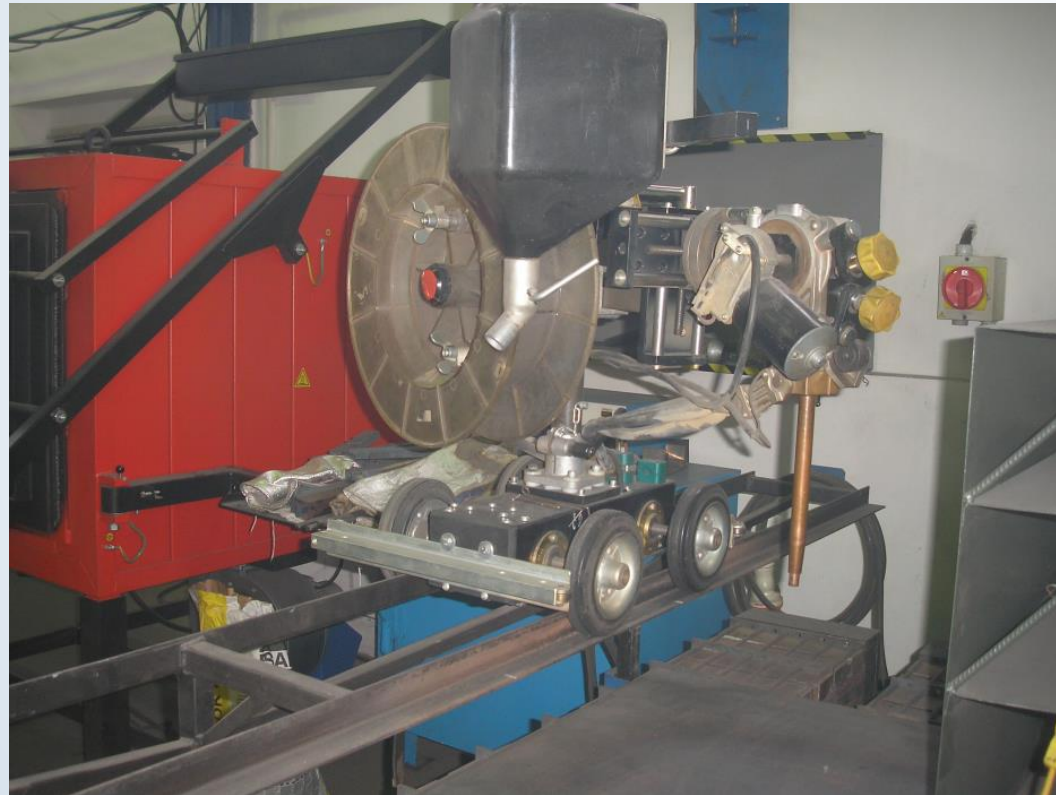


Using a submerged arc welding

- ▶ Submerged arc welding is a specific type, it can be used by a small thickness of material to thicknesses greater than 50 mm (where the uses specific treatment areas for welding - welding in a narrow bevel).
- ▶ Use welding of this in practice is very diverse, ranging from the production of various complex structures, pressure vessels after the welding of high alloy steels.



Equipment for submerged arc welding





Questions to ponder

1. What is the principle method of submerged arc welding?
2. From what thickness is generally used submerged arc welding?
3. Which uses the method of submerged arc welding?
4. What are the main parameters for submerged arc welding?
5. What is characteristic of submerged arc welding?
6. Which filler materials are used in the submerged arc welding?
7. What fluxes are used in the submerged arc welding?



Recommended literature and information sources

- ▶ AMBROŽ, O. A KOL. *Technologie svařování a zařízení: učební texty pro kurzy svářečských inženýrů a technologů*. Ostrava: ZEROSS, 2001, 395 s. Svařování. ISBN 80-85771-81-0.
- ▶ BERNASOVÁ, E. A KOL. *Svařování*. 1. vyd. Praha: SNTL, 1987. ISBN 04-221-88.
- ▶ KUBÍČEK, J. DANĚK, L. KANDUS, B. *Technologie svařování a zařízení. Učební texty pro kurzy svařovacích inženýrů a technologů*. Plzeň: ŠKODA WELDING, s. r. o., 2011, 242 s.