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# A MODULE

## Introduction to the problems of welding

Crystallization of weld metal



## Crystallization of weld metal

- Solidification of the weld metal formed crystals. The resulting crystals have different shapes. According to the process of growth distinguish:
  - Planar crystals
  - Cellular crystals
  - Dendrites



# Crystallization of weld metal

- ▶ The crystals grow in the plane only for pure metals, which welding is irrelevant.
- ▶ Dendrites first and fastest growing primary axis, then in the secondary and tertiary.
- ▶ Dendrites they grow so long before it collided, because their elongated shape.
- ▶ At fusion welds weld metal crystallization takes place below the liquids temperature.
- ▶ Metal crystallizes in two fronts.
- ▶ In first crystallization front dendritic crystallization significantly affects plastic properties of the weld metal.
- ▶ Rougher and larger dendrites reduce toughness and plastic properties. It is necessary to make crystallizing dendrites were as small as possible.



This is achieved by:

- Reduction applying heat to the weld
- Use additional small diameters materials
- Reduction welding parameters
- Welding pulse shock
- fine alloying Weld Al, Zr, Ti



# Crystallization of weld metal

- ▶ The plastic properties of the weld metal also improves the thermal treatment.
- ▶ Must but thus handle the entire structure.
- ▶ Like heat treatment is used normalization.
- ▶ The weld metal is prone to crystallization cracking, particularly the cracking of the axis.
- ▶ Appears mainly in root caterpillars and reduces the capacity of the coupling.
- ▶ Crystallization cracking supports a large carbon content.



# Crystallization of weld metal

- The weld pool is molten filler material mixed with the melted base material, but complete mixing does not occur in the weld pool.
- In due to the different chemical composition of the base and filler metal.
- Big heterogeneity is mainly in multilayer welded joint.
- At welding also appear liquid and segregation processes.
- Depends the chemical composition of the weld metal, also have influence the welding parameters.
- On the mechanical properties of weld metal is affected by many factors, e.g. microstructure, a method of crystallization, precipitation processes, chemical composition, and aging.





# Questions to ponder

1. How way you can create a welded joint?
2. Explain principle of fusion welding.
3. Describe the essence of pressure welding.
4. How manner a joint at the pressure welding?
5. How manner a joint fusion welding?
6. What is a thermal cycle of welding?
7. What the heat source for fusion welding?
8. What parameters characterizing thermal cycles?
9. What are the bands heat affected zone of weld joints?



## Questions to ponder

10. As uses the knowledge of temperature cycles in practice?
11. What These are precipitation processes in TOO?
12. Explain TOO inclusions in the concept.
13. Characterize weld metal.
14. Explain what is dross.
15. Description methods for alloying of the weld metal.
16. Explain refining weld metal.
17. describe gas absorption in the weld metal.
18. Explain formation of the weld puddle.





## 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. Praha: SNTL, 1987. ISBN 04-221-88.
- ▶ KOUKAL, J., SCHWARZ, D., HAJDÍK, J. Materiály a jejich svařitelnost. 1. vyd. Ostrava: VŠB – Technická univerzita Ostrava, 2009, 240 s. ISBN 978-80-248-2025-5.
- ▶ 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.