Third School Year

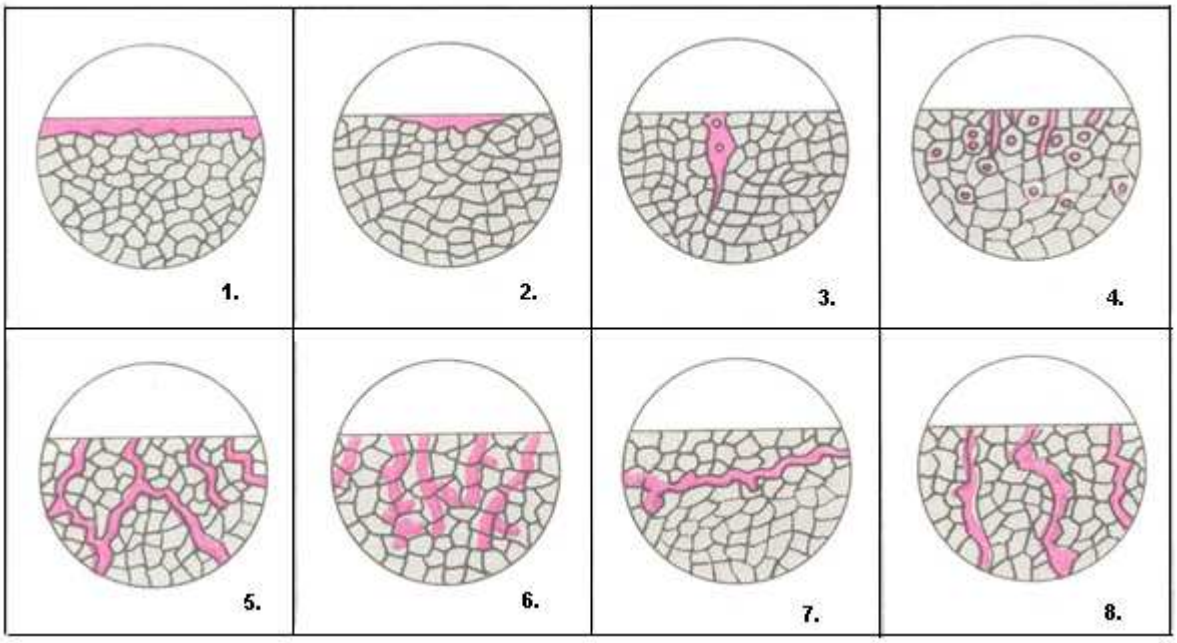
CORROSION

Corrosion is the disturbance of material due to the environment. According to the distribution of ***corrosion*** we can divide it into two basic groups:

a) ***Uniform corrosion*** – it forms a little connected ***layer*** on the surface of a material which is ***impermeable*** for the environment and this ***prevents*** the ***growth*** of further ***corrosion***. Typical representatives of metals which continuously corrode are ***copper*** and aluminium.

b) ***Non-uniform corrosion*** – ***corrosion*** forms a non-continuous coat on the surface of a material, which does not slow down the course of further ***corrosion***. Typical examples of non-continuous corroding materials are the ***alloys*** of iron.

Kinds of *Corrosion*



1. ***uniform***
2. ***non-uniform***
3. ***point***
4. ***selective***
5. intercrystalline
6. transcrystalline
7. ***corrosive crack***
8. ***corrosive fracture***

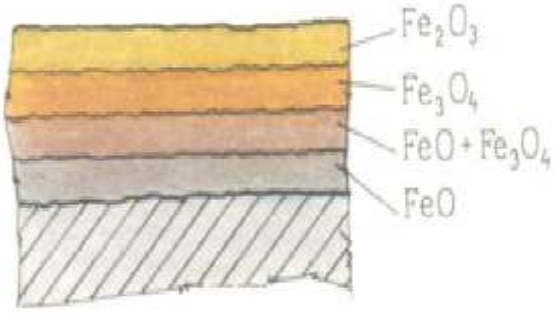
Corrosion can take place **in electrically *non-conductive* environments** (that is **chemical *corrosion***) and **electrically *conductive* environments** (that is **electrical-chemical *corrosion***).

Chemical *corrosion*

We meet most often with chemical ***corrosion*** when material is heated before thermal treatment, through ***forming***, during ***welding*** and ***soldering*** and similar processes.

Oxides are the product of chemical ***corrosion***. In higher temperatures they form ***scales***, which are created by the ***layers*** of different oxides. In temperatures around 800 ° C ***scales*** fall off the surface and ***corrosion*** then grows intensively. Protection is possible by heating in a protective environment, or using WIG or MIG ***welding*** methods, or other methods.

Chemical composition of scales



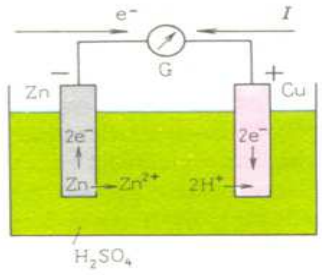
Electrical-chemical *corrosion*

Electrical-chemical ***corrosion*** forms most often and it is founded on the principle of the functioning of a galvanic ***cell***. The greater the intensity of this ***cell*** (and of ***corrosion*** as well), the warmer and more ***conductive*** the environment. The „electrodes“ (of the parts making up the galvanic ***cell***) are from various materials.

Material ***nobility*** determines the tendency of material to corrode and it is determined by the electrical-chemical potential of a material.

Examples of the *nobility* of various materials:

Element	**Magnesium**	**Aluminium**	**Zinc**	**Iron**	**Tin**	**Copper**	**Silver**	**Gold**
Potential (V)	-2,34	-2,07	-0,76	-0,44	-0,14	+0,34	+0,80	+1,50



The principle of a galvanic ***cell***

$Zn \rightarrow Zn^{++} + 2e^-$

$H_2SO_4 \rightarrow 2H^+ + SO_4^{--}$

$Zn^{++} + SO_4^{--} \rightarrow ZnSO_4$ (it lays on the bottom of a ***cell*** and slows ***corrosion***)

$2H^+ + 2e^- \rightarrow H_2$ (it ***diffuses out***)

Corrosive **macro-cell** – it forms by connecting two or more mechanical parts, which have different ***nobility*** and are found in electrically ***conductive*** (moist) environments.

Corrosive **micro-cell** – it forms in the individual ***cells***, which are found in electrically ***conductive*** environments. They can be for example, at a weld, which connects the basic material of different ***nobility*** than the electrode ***nobility*** is. In a chemically ***pure*** metal are formed galvanic micro-***cells***, because of the lower electrical-chemical potential on the ***edge*** of the ***grain***. Surfaces with great ***roughness*** yield to electrical-chemical ***corrosion***, because little tops of ***unevenness*** have a different potential than lower surface areas.

Literature and sources used: Hluchý a kolektiv: Strojírenská technologie 2, SNTL, Internet, Interní odborné texty SPŠ

VOCABULARY

alloy	slitina
aluminium	hliník
cell	článek
conductive	vodivý
copper	měď
corrosion	koroze
corrosive	korozní
crack	trhlina
diffuse out	difundovat
forming	tváření
fracture	lom
grain	zrno
growth	růst
impermeable	nepropustný
layer	vrstva
metal	kov
nobility	ušlechtilost
non-conductive	nevodivý
non-uniform	nerovnoměrný
point	bodový
prevent	předcházet, zabraňovat
pure	čistý
roughness	drsnost
scale	okuje
selective	selektivní, výběrový
soldering	pájení
unevenness	nerovnost
uniform	rovnoměrný
welding	svařování

COMPREHENSION QUESTIONS

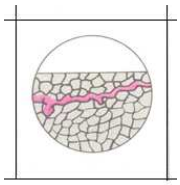
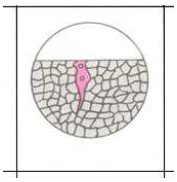
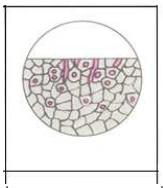
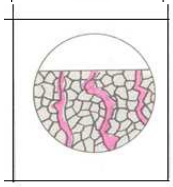
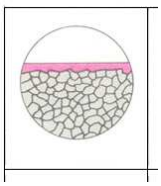
1. What is corrosion?
2. How is corrosion divided?
3. What kinds of corrosion do you remember from the text?
4. Where do we meet the chemical corrosion?
5. What is material nobility?

EXERCISES

1. Match the verbs with their definitions:

1	fracture	**a**	the conditions that sth exists in
2	surface	**b**	an increase
3	pure	**c**	the same in all parts and at all times
4	corrosion	**d**	a break in the hard material
5	growth	**e**	to join pieces of metal together by heating
6	uniform	**f**	the outside or top layer of sth
7	environment	**g**	clean
8	welding	**h**	to destroy sth slowly by chemical action

2. Match the pictures with their descriptions:

1	selective	**a**	
2	uniform	**b**	
3	corrosive crack	**c**	
4	point	**d**	
5	corrosive fracture	**e**	

3. Translate the expressions into English:

1	korozní lom	_____
2	chemická koroze	_____
3	slitiny železa	_____
4	galvanický článek	_____
5	svařování	_____
6	ušlechtilost materiálu	_____
7	vodivé prostředí	_____
8	velká drsnost	_____
9	čistý kov	_____
10	nerovnost	_____

EXERCISES – KEY FOR TEACHERS

1. Match the verbs with their definitions:

1	fracture - **d**	**a**	the conditions that sth exists in
2	surface - **f**	**b**	an increase
3	pure - **g**	**c**	the same in all parts and at all times
4	corrosion - **h**	**d**	a break in the hard material
5	growth - **b**	**e**	to join pieces of metal together by heating
6	uniform - **c**	**f**	the outside or top layer of sth
7	environment - **a**	**g**	clean
8	welding - **e**	**h**	to destroy sth slowly by chemical action

2. Match the pictures with their descriptions:

1c 2e 3a 4b 5d

3. Translate the expressions into English:

1	korozní lom	**corrosive fracture**
2	chemická koroze	**chemical corrosion**
3	slitiny železa	**alloys of iron**
4	galvanický článek	**galvanic cell**
5	svařování	**welding**
6	ušlechtilost materiálu	**material nobility**
7	vodivé prostředí	**conductive environment**
8	velká drsnost	**great roughness**
9	čistý kov	**pure metal**
10	nerovnost	**unevenness**