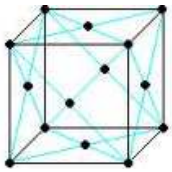
Third School Year

HOT-FORMING

1. Introduction

By ***hot-forming*** we change the shape of a ***semi-product*** into a future product by working ***external forces*** at an ***increased*** temperature. The material used has to be ***formable*** enough, and it means with a large ***amount*** of plastic ***deformation*** and with a small ***amount*** of elastic ***deformation***. Steel is the most ***formable*** in the area of ***austenite***, which has a ***cubic grid*** which is surface-centred – see Picture 1.

Picture 1



2. The *influence* of temperatures on plastic *deformation*

Higher temperatures ***reduce deformed resistance***, but ***increase*** corrosion (***melting*** loss) and ***cause grain roughness***. Low temperatures ***cause*** an ***increase*** in ***deformed resistance*** of material.

3. Material *heating* before *forming*

Material ***heating*** is ***carried out uniformly*** in ***furnaces***, which ***reduces*** material ***melting*** loss. The most often used 3 classifications for furnaces are:

a) according to heat source
- electric
- ***gas***

b) according to structure
- ***chamber***
- ***shaft***
- ***car hearth***

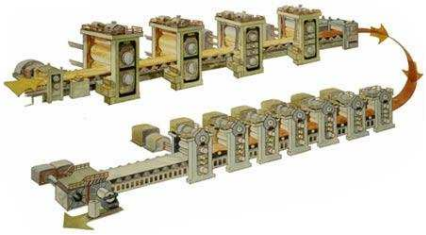
c) according to method of *heating*
- continual (continuous)
- ***cyclic***

4. *Hot-forming* technologies

4.1 *Rolling*

Rolling is ***carried out*** in ***rolling mill*** factories on ***rolling mill lines*** – see Picture 2. The ***semi-product*** for ***rolling*** is an ***ingot*** – see Picture 3, a product from a ***steelworks***. An ***ingot*** is deformed into ***slabs*** or ***billets***.

Picture 2 – A rolling line



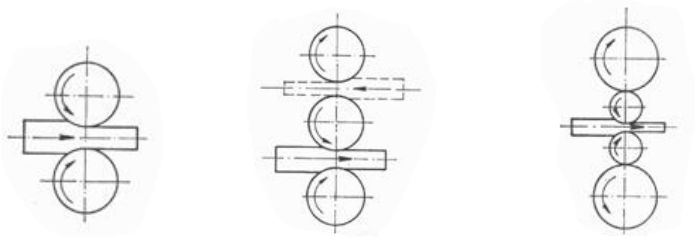
Picture 3- Ingots

4.1.1 *Rolling stands*

The ***rolling mill line*** is made up of ***rolling stands***. There are several ***rolling stand*** structures which are named according to the number of ***rolls*** they have.

a) Basic kinds of rolling stands – see Picture 4

Picture 4



Two-roll (two-high) *Three-roll(three-high)* *Four-roll (four-high)*

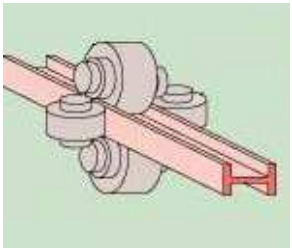
The two-***roll stands*** are structurally the simpliest but they do not ***enable*** big cross ***section*** reductions.

b) Kinds of *rolls*

- ***flat*** – for ***rolling plates*** (see Picture 5)
- ***grooved*** – for ***rolling sections*** (see Picture 6)

Picture 5

Picture 6



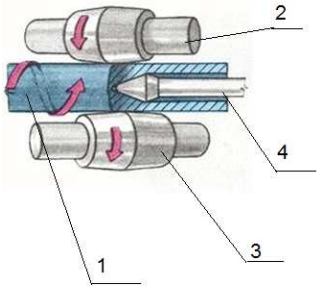
4.1.2 *Rolling plates*

Plates are ***hot-rolled*** and ***cold-rolled***. ***Cold rolling increases*** the ***accuracy*** of a ***plate´s dimensions***.

4.1.3 *Rolling tubes*

Tubes are most often ***rolled*** using the Mannesman (see Picture 7). Its **rolls** have the same sense of rotation. ***Rolls increase tension*** in the ***semi-product axis*** above breaking ***strength causing*** the formation of ***cracks***. ***Tension gradually*** increases and the ***mandrel*** then ***smooths*** the ***tube cavity***.

Picture 7 – The Mannesmann method

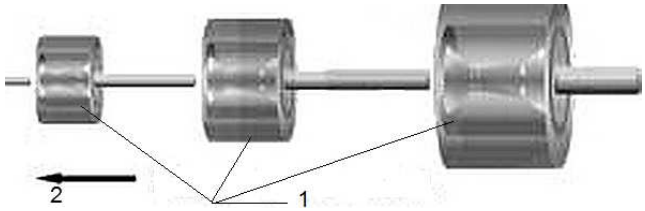


1. Semi-product 2. Upper roll 3. Lower roll 4. Mandrel

4.2 *Drawing wire*

During ***drawing wire*** a ***semi-product*** goes through a series of ***dies*** (see Picture 9), which ***gradually reduce*** the ***wire*** cross ***section***.

Picture 9



1. Dies 2. Semi-product motion direction

Literature used and picture sources: *Miroslav Hluchý and co: Engineering Technology 2, SNTL, Internnal specialists texts SPŠ, Technologie II – TU Liberec, Internet*

VOCABULARY

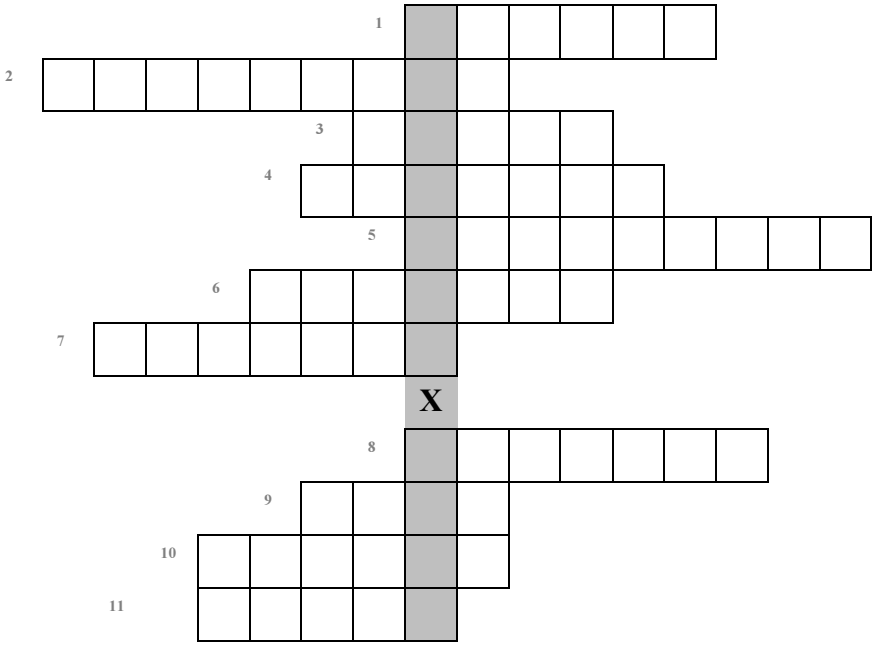
accuracy	přesnost	**hot-forming**	tváření za tepla
amount	množství	**hot-rolled**	válcovaný za tepla
austenite	austenit		
axis	osa	**chamber**	komorový
billet	sochor	**increase**	zvýšit
car hearth	vozový	**increased**	zvýšený
carry out	probíhat	**influence**	vliv, ovlivňovat
cause	způsobit	**ingot**	ingot
cavity	dutina	**lower**	dolní
cold-rolled	válcovaný za studena	**mandrel**	trn
		melting	tavení
crack	trhlina	**plate**	plech
cubic	krychlový	**property**	vlastnost
cyclic	cyklický	**reduce**	snížit
deformed resistance	přetvárný odpor	**roll**	válcovat, válec
deformation	deformace	**rolling**	válcování
die	průvlak	**rolling mill**	válcovna
dimension	rozměr	**rolling mill line**	válcovací trať
drawing	tažení	**rolling stand**	válcovací stolice
enable	umožnit	**roughness**	hrubost, drsnost
external	vnější	**section**	profil (ocelový)
flat	plochý	**semi-product**	polotovar
force	síla	**shaft**	šachtový
formable	tvárný	**slab**	brama
forming	tváření	**smooth**	dohladit
furnace	pec	**steelworks**	ocelárna
gas	plyn, plynový	**strength**	pevnost
gradually	postupně	**tension**	napětí
grain	zrno	**tube**	trubka
grid	mřížka	**uniformly**	rovnoměrně
grooved	kalibrovaný	**upper**	horní
heating	ohřev	**wire**	drát

COMPREHENSION QUESTIONS

1. What do we change by hot-forming?
2. What do you know about the influence of temperatures on plastic deformation?
3. How do we classify furnaces?
4. How is rolling carried out?
5. What kinds of rolls do you know?
6. How are the tubes often rolled?
7. What happens during wire drawing?

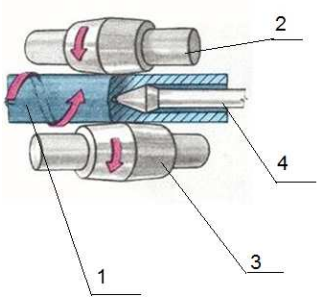
EXERCISES

1. Complete the crossword and translate the vertical word:



1	snížit	**7**	tažení
2	rozměr	**8**	trn
3	plech	**9**	mřížka
4	tavení	**10**	umožnit
5	vliv, ovlivňovat	**11**	ocel
6	pec		

2. Describe the picture below and then translate:



3. Complete the following sentences from the text. Use the words below.

rolling stands	**hot-rolled**	**ingot**	**hot-forming**
grooved	**reduce**	**drawing**	**tubes**

1 During wire _____ a semi-product goes through a series of dies.

2 The semi-product for rolling is an _____ .

3 By _____ we change the shape of a semi-product.

4 The rolling mill line is made up of _____.

5 Plates are _____ and cold-rolled.

6 Higher temperatures _____ deformed resistance.

7 _____ are most often rolled using the Mannesman method.

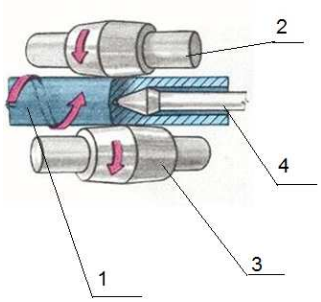
8 Rolls are flat or _____.

KEY – for teachers only

1. ROLLING MILL

1	reduce	**7**	drawing
2	dimension	**8**	mandrel
3	plate	**9**	grid
4	melting	**10**	enable
5	influence	**11**	steel
6	furnace		

2.



1. Semi-product – polotovar
2. Upper roll – horní válec (kotouč)
3. Lower roll – spodní válec (kotouč)
4. Mandrel - trn

3.

1 During wire drawing a semi-product goes through a series of dies.

2 The semi-product for rolling is an ingot .

3 By hot-forming we change the shape of a semi-product.

4 The rolling mill line is made up of rolling stands.

5 Plates are hot-rolled and cold-rolled.

6 Higher temperatures reduce deformed resistance.

7 Tubes are most often rolled using the Mannesman Stiefel method.

8 Rolls are flat or grooved.