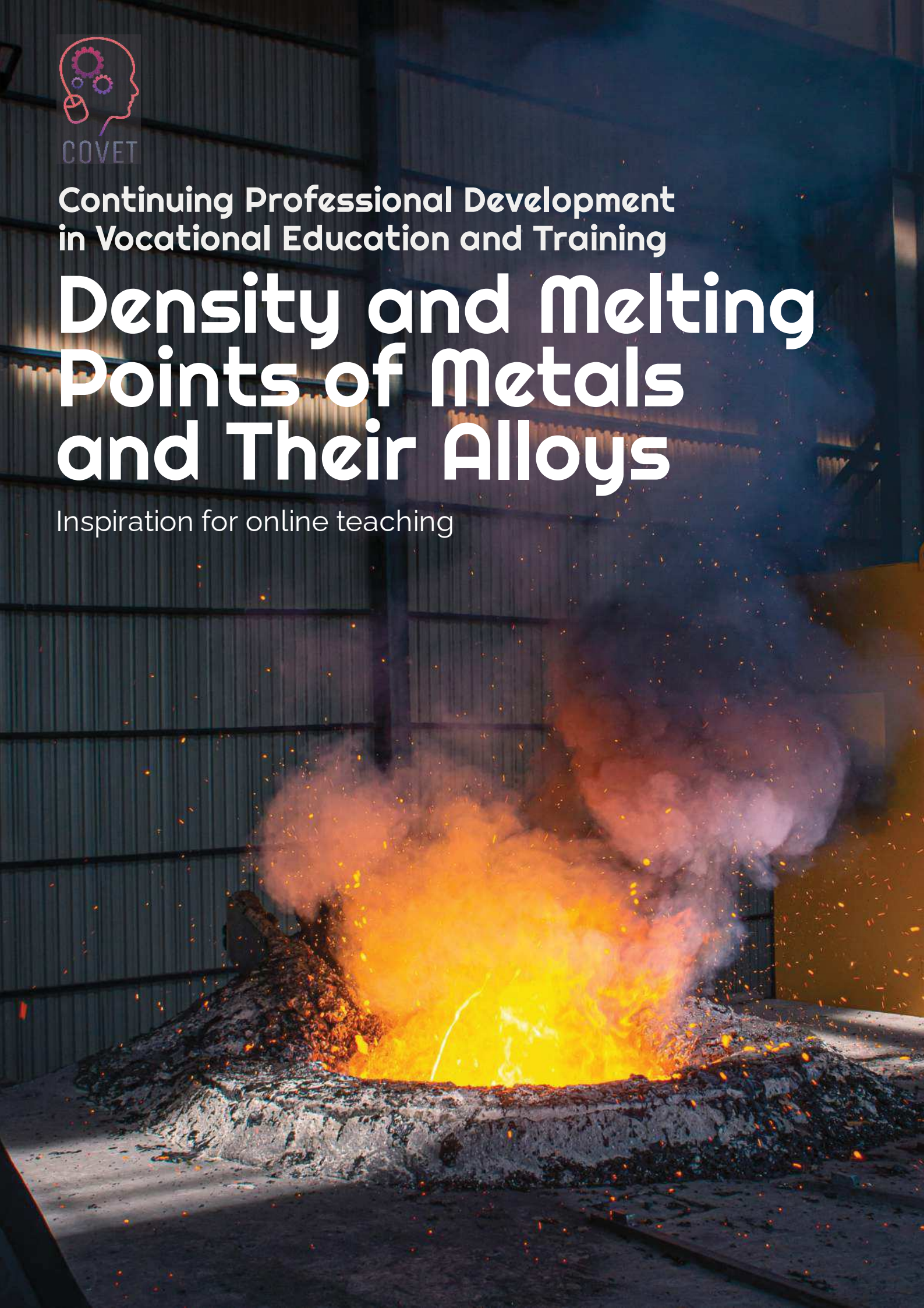
COVET

Continuing Professional Development in Vocational Education and Training

Density and Melting Points of Metals and Their Alloys

Inspiration for online teaching



In the COVET project, we have collected many great examples of teaching that have been transformed from the classic off-line version into a modern online learning method.

These sample lessons have been created by VET teachers from different EU countries. We present them to you as inspiration for your work.

The lessons are particularly suitable for vocational teachers, but can also serve as a training tool for teachers, trainers and lecturers in other educational settings.

All sample lessons, training materials as well as all information about the project are available at:
https://www.covet-project.eu/

Co-funded by the
Erasmus+ Programme
of the European Union

Density and Melting Points of Metals and Their Alloys

Partly online, can also be done fully online

1st year apprenticeship metalworker programme

Off-line version of the preparation

Goal

Students understand the concept of density and can explain its importance in calculating the mass of components. They remember the division of light and heavy metals. They know the basic unit of density, and can convert density units from one to another, especially kg/m^3 to kg/dm^3. They know the density of steel, titanium, aluminium, magnesium and copper by heart. They know how they can look up the density of pure metals and their base alloys.

Students can define the melting point of metals and can explain what Kelvin and Celsius mean. They can compare the melting points of some metals and explain that the technology of casting components from a metal with a high melting point is much more energetically demanding.

Teaching methods

interpretation, problem-based interview, simple animations, samples of several types of metals, searching densities and melting points in the table in PPT presentation and other activities according to the current situation

Aids

Samples of several types of metals

Presentation: animation of different sized cubes of different materials, names of metals and their density and melting point

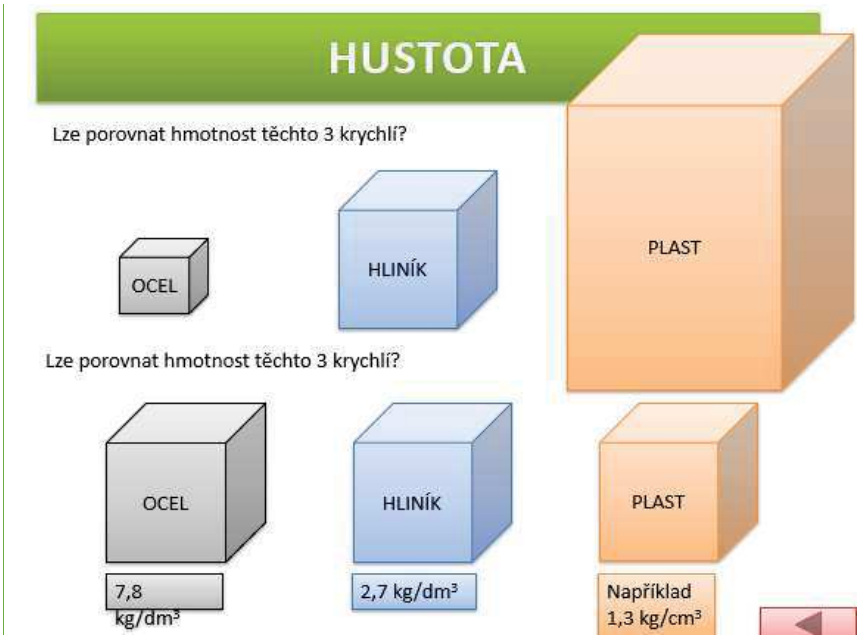
Teaching texts summarising the material taught. They will be given out after the lesson.

The course of activities in the lesson

- Interpretation of density using problem-based interview
- Finding the densities of the metals from the table in the PPT presentation and classifying them into light and heavy metals, and especially comparing them
- Names of basic alloys of copper, aluminium and magnesium, estimation of their density and comparison with the density of steel
- Interpretation of the definition of melting point. The importance of this knowledge for various metal processing technologies - casting, welding...

- Finding the melting points of several metals from the table in the PP presentation and comparing them
- Distribution of teaching texts
- Evaluation of each individual lesson
- Following the closure of schools I was encouraged to introduce more online-teaching elements into everyday practice. It enabled me to utilise my growing set of online materials produced by me and I could also use my knowledge of various tools. When you start creating such a set of materials, it certainly enables you to use them more times and improve them on the basis of the feedback received from students.

Several slides from the *PPT presentation*



TEPLOTA TAVENÍ

PROČ POTŘEBUJEME ZNÁT TEPLOTU TAVENÍ MATERIÁLU:

Výroba součástí z materiálů s vysokou teplotou tavení by byla velmi drahá – např. WOLFRAM, karbidy wolframu… (spékání)

Můžeme využívat materiály podle teploty tavení:

KOMPOZICE DO KLUZNÝCH LOŽISEK – nezadře se – v ložisku se roztaví kompozitní kov, nezničí se ostatní součásti.

PÁJKY – u měkkého pájení používáme pájky s teplotou tavení do 500°C …,

U OBRÁBĚNÍ nesmí v místě řezu vzniknout teplota, která by natavovala obrábějící materiál… (diamant se taví při 3 816°C, železo při 1 536°C, hliník při 658°C…)

Kov	Teplota tání t_t [°C]	Teplota varu t_v [°C]	Hustota ρ [kg.dm^{-3}]	Pevnost v čistém stavu R_m [MPa]
Kovy s nízkou teplotou tání				
Olovo	327	1740	11,340	15
Cín	232	2270	7,280	30
Zinek	419	907	7,130	120
Lehké kovy				
Hliník	660	2467	2,700	70
Hořčík	649	1090	1,740	180
Titan	1660	3287	4,530	400
Kovy se střední teplotou tání				
Měď	1083	2567	8,930	180
Nikl	1453	2732	8,900	350
Mangan	1244	1962	7,300	
Ušlechtilé kovy				
Zlato	1064	3080	19,290	120
Stříbro	962	2212	10,500	150
Platina	1772	3827	21,450	200
Kovy s vysokou teplotou tání				
Chrom	1850	2672	7,100	
Molybden	2617	4612	10,200	
Wolfram	3410	5660	19,300	

1) Které z uvedených kovů by se hodily na výrobu měkké pájky – teplota tavení do 500°C?
2) Který z uvedených kovů má nejvyšší teplotu tavení?

Online version of the preparation

This is an important topic which is part of the final exams. I needed the students to be able to search for information, interpret it, and to analyse sources. Such abilities are essential for learning however sometimes difficult to achieve with apprentices. And I needed my students to become confident in doing so. That is why I decided to involve online elements.

Although students like searching the Internet for fun, in case of more specialised information they do not know what phrase (keyword) to enter into the search engine in order to be led to information they are looking for as quickly as possible. They make mistakes in spelling and in the correct technical terms, and they are frequently not capable of refining the keyword so that they would not search for information from a completely different field. Working online on a PC or mobile is different when searching for professional information and different when searching for entertainment. For professional information, it is important to compare sources to see if they are not just copies of a single source. In such a case it is important to find the original source and search for another source as well. You can never trust just one source. **In order to work online and learn to enter correct search terms and be aware of the quality of the information source, students work with their mobile phones and search independently for the information needed for the assignment**. Drawing their own conclusions from the information is very difficult for first year students, some fear their own opinion would be wrong or mocked, others refuse to think etc. Therefore, to start with, I have looked for a simple task where **they could draw the required conclusions themselves and could be very confident that they were correct.**

At school students are connected to the internet using the school Wi-Fi network.

I created a worksheet for them to write down the values of density and melting points of metals and their alloys that they found online. The students were tasked to draw their own conclusions from the information they have found.

Worksheet

DENSITY AND MELTING POINT OF METALS AND THEIR ALLOYS

worksheet

1) Use the internet to find the values of **density and melting points** of the metals and alloys in the table below. Classify the pure metals as either heavy or light, if you know that heavy metals have lower density than 5kg/dm3.

Metal/Alloy	Density	Unit of density	Heavy/Light metal	Melting point
Steel		kg/dm3		
Aluminium				
Magnesium				
Titanium				
Copper				
Lead				
Zinc				
Tin				
Wolfram				
Cobalt				
Platinum				
Gold				
PC (plastic)				
Duralium				
Elektron				
Bronze				
Brass				

1) Který z **kovů** z uvedených v tabulce má nejnižší hustotu?

.....

2) Jakou hmotnost by měla krychle o délce strany 10cm vyrobená z hliníku a kolik stejná krychle vyrobená z oceli?

.....

3) Bude mít díl vyrobený z hořčíku větší hmotnost než stejný díl o stejném objemu materiálu vyrobený z mosazi?

.....

4) Porovnejte hmotnost dvou součástek o stejném objemu, kdy jedna je vyrobena z mosazi, druhá je vyrobena z oceli.

.....

.....

5) Které z kovů v tabulce výše by se hodily na výrobu měkké pájky, jestliže její teplota tavení musí být do 500°C?

.....

6) Který z kovů v tabulce výše má nejvyšší teplotu tavení?

.....

The course of teaching has therefore changed as follows:

- Interpretation of density using problem-based interview
- Names of basic alloys of copper, aluminium and magnesium, estimation of their density and comparison with the density of steel.
- **Students independently search for the densities of metals and their alloys using internet sources. Classify them as light and heavy metals, complete tasks and draw their own conclusions by comparing densities.**
- **Discussion of the developed solutions.**
- Interpretation of the definition of the melting point. The importance of this knowledge for various metal processing technologies - casting, welding...
- **Finding the melting points of selected metals and some of their alloys using internet sources. Completing assignments and making their conclusions based on the value of melting points of the selected metals.**
- **Discussion of the developed solutions.**
- Distribution of worksheets
- Evaluation of each individual lesson

Feedback on the lesson

The current problem in schools and everyday life, in times of access to loads of information in an instant, primarily seems to be the lack of education focused on critical thinking, media literacy, and the handling of resources and information. We have been reforming education for 20 years, or talking about it, but nothing fundamental has actually happened or is happening. And I feel that it is something I need to do with my students, in a field of science which should provide clear and unbiased results.

Searching online was rather difficult at first due to the setbacks I mentioned earlier on. It also took longer as the students were not provided with a single source of information. This was our very first lesson in which I asked them to search online themselves. As we have started using it during other lessons too, they became more confident in using their own skills. Of course the students are not always ready to become involved, you have to be careful not to let them become distracted while online. However the online element proved to be useful for them as well as for me, as I learned more about their ways of thinking and their knowledge of the online environment. It helped me to adjust and modify our other online activities.

Erasmus+
Continuing Professional Development
in Vocational Education and Training

2020-1-CZ01-KA226-VET-094350

https://www.covet-project.eu/

Co-funded by the
Erasmus+ Programme
of the European Union