

Report of LEARNIN'S CREATIN' workshop

Addressing SI&TD problems, decreasing dropout and improving student outcomes, using active learning methodologies



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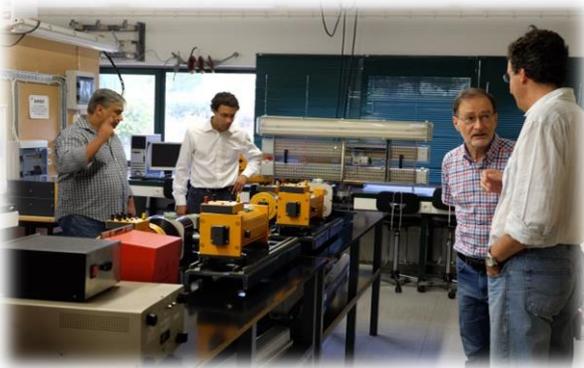
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1. First meeting with Christian Liebelt and Yves Rosefort

The first meeting, held in August, started with an institutional presentation by the ESTGV Vice-President. Followed by a presentation and discussion of the project tasks, a visit to the Pellets Power factory and to the ESTGV labs.



During this meeting a first analysis of the available installation scheme was made, that is represented in Figure 1. Energy balances were addressed and the points and quantities to measure were identified:

- 1 - exhaust gases output (mass flow rate, temperature, pressure, lambda);
- 2 - exhaust gases recirculation (flow rate, temperature, pressure);
- 3 - fuel in the furnace (mass flow rate, composition, relative humidity);
- 4 - exhaust gas output (temperature, pressure, lambda);
- 5 - gas in the dryer (temperature, pressure, relative humidity);
- 6 - gas outlet from the dryer (temperature, pressure, relative humidity can be assumed 100%);
- 7 - after the cyclones (temperature, pressure);
- 8 - chimney output (temperature, composition);
- 9 and 10 - inlet air (primary and secondary) - check the possibility of evaluating the mass flow rate through the fan diagrams).

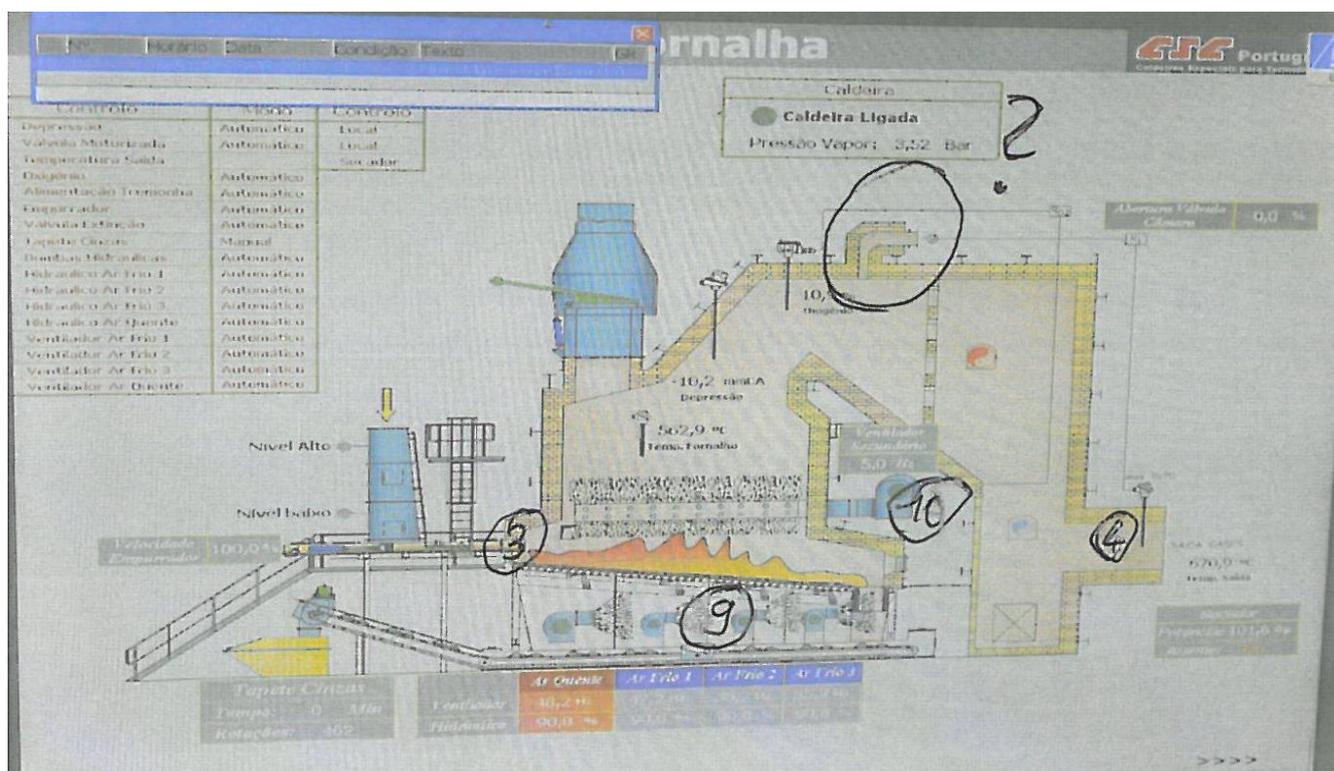
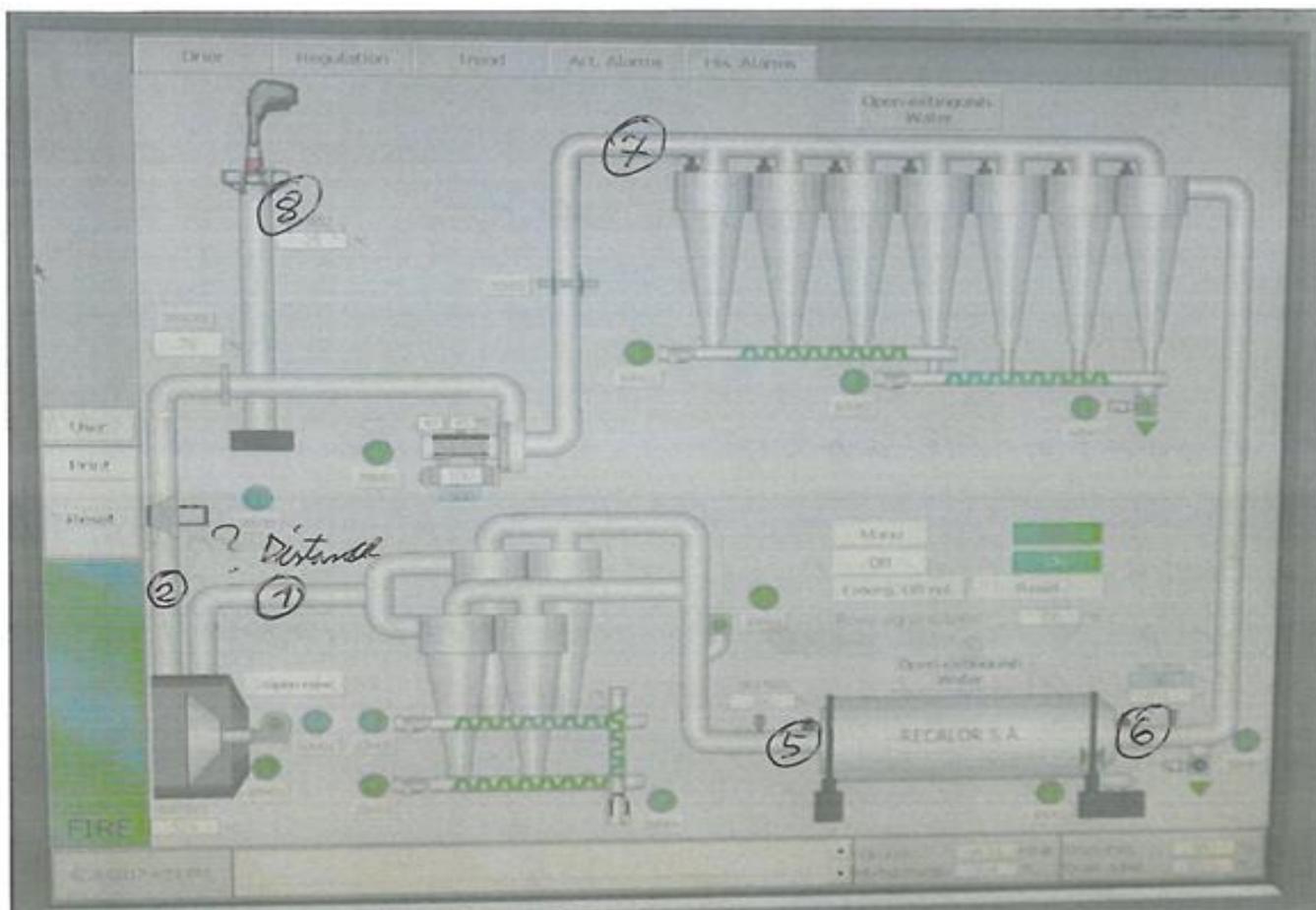


Figure 1: Real installation diagram obtained in the operations control center.

Some sensors and data acquisition systems, namely lambda probes (Bosch LSU 4.9 or Innovate LC2), temperature, pressure and relative humidity sensors, pitot tubes and DataLoggers were analyzed. In DataLoggers issues, two approaches were considered: the use of an existing one (at the University of Applied Sciences Dortmund) or the construction of one, from the “Arduinos” (referred by Yves Rosefort) or “Raspberry Pi” (referred by Stefan Göessner), which eventually could be included in courses of Electrotechnical Engineering.

It was considered interesting the determination of the thermal losses of the Pellets Power installation, by using the laws of Heat and Mass Transfer.

It was also agreed that the group of students directly involved in the project would have a counterpart in Dortmund, with the same tasks, that could communicate by Moodle, Skype, or another platform to share some data, information and results.

At the end of the two-day meeting some issues related with the scheme of the installation (Figure 1) and about unknown information were discussed, such as:

- the information about the inlet air at the top of the furnace;
- the type of measurement instruments which are installed;
- the type of data that the factory monitoring system acquires and registers;
- the possibility of access to the piping for installation of measuring equipment (drill holes, for example);
- the possibility to change the recirculation flow rate of the exhaust gases.

Furthermore, the measurement of the fuel gas composition and the proximate and ultimate analysis were also discussed. Perhaps, the Environment Department will do these analyzes, or if the costs justifies, they can be made in Germany.

Regarding to the measurement of the exhaust gas composition, it will be necessary check the availability of Institute Polytechnic of Castelo Branco to do the FTIR analysis.



2. Learnin's Creatin' Workshop – 13th and 14th of September

The Learnin's Creatin' workshop was held at School of Technology and Management of Viseu, room 21, was attended 38 participants.



The first part of the workshop consisted on a presentation of Professor Francesc Xavier Giménez Font (Barcelona's University), with the title "Let's make high academic performance possible". There, was explained and discussed in detail the active learning methodology - SABER (Annex 3).

On the second part, the participants were informed about how this type of methodology should work on a regular class (Annex 4). So that later they could form a group and solve an activity sheet related with chemical bonding, an example is shown in annex 5. The main goal of this stage was to simulate a real class of active learning.

On the last part of the workshop, some IPV Professors presented cases of Active Learning and Educational Modernization applied on their classes at the school.



When the workshop was concluded, Xavier Gimenez and Edmundo Marques met to discuss the involvement and participation of the students in solving some of the specific problems of the factory, by using active learning methodologies, in particular, SABER methodology. It would be stimulating to create an activity sheet for tasks of acquisition, analysis and interpretation data. The correction of this sheet would be at charge of the senior researchers that accordingly with the results obtained from the data would promote some actions of coaching, which would facilitate the analysis and discussion between the students.

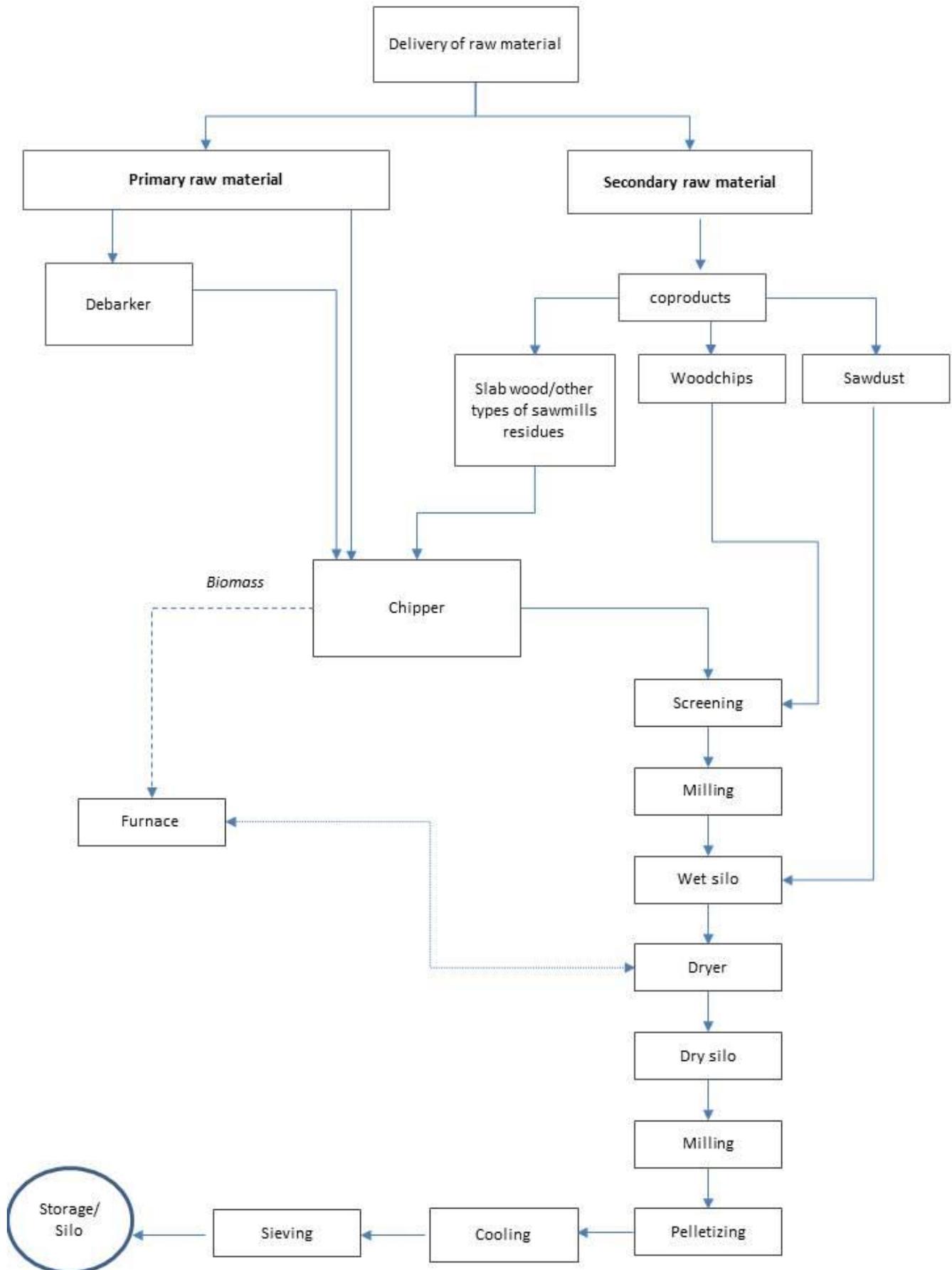
The operationalization of this activity, would not allow all the students to move to the factory, but it could be based on a “peer learning logic”, in which a select group of students would visit this factory, compiling data and complementary information to disseminate and discuss them among colleagues. This same data/information would be also shared with students from University of Applied Sciences and Arts, Dortmund – Germany, which would be studying the same problems. Resulting on the development of a relationship between students, from both countries, by exchanging the information collected.

The participation of students on the production of prototype's equipment, is by itself an active methodology, thus small groups of mechanical engineering students focused on the design and construction of those prototypes are an active way of learning.

On the next day, the participants of the workshop visited two sites, Câmara Municipal de Mortágua and Pellets Power, followed by a presentation session of IPV projects that was made in Aula Magna – IPV, during the afternoon.



Annex 1 – Flowchart of Pellets Power



Annex 2 - Workshop Program



Learnin's Creatin' Workshop

Addressing SR&TD problems, decreasing dropout and improving student outcomes,
using active learning methodologies

▪ **September 13, 2017**

Place: Escola Superior de Tecnologia e Gestão de Viseu (room 21)

9.00h Registration

9.30h Opening

10.00h "Let's make good academic performance possible" – Part 1
(Dr. Francesc Xavier Giménez Font)

12.30h Lunch

14.00h "Let's make good academic performance possible" – Part 2
(Dr. Francesc Xavier Giménez Font)

16.30h Active Learning/Education Modernization cases

20.00h Dinner

▪ **September 14, 2017**

Place: Mortágua and IPV

9.30h Câmara Municipal de Mortágua and Pellets Power site visits

12.30h Lunch

14.00h ESAV and ESTGV visits

[16.30h Presentation session of IPV projects]

20.00h Dinner

PARTNERS:



**Fachhochschule
Dortmund**
University of Applied Sciences and Arts



Instituto Politécnico
de Castelo Branco



**Amsterdam University
of Applied Sciences**



Gesfinu

SUPPORT BY:



Capuchinha do Rossio

Annex 3 - SABER Methodology



The main disadvantage of traditional classes, in scientific fields, is that 75% of the students disconnect from the lecture, due to the complexity of the subject and difficulty in following the teacher's speech. The methodology, SABER, consists in a process of teaching mathematics and science through the resolution of doubts and autonomous work. This methodology propose the total replacement of the traditional classes.

The intention of this method is developing a new teaching material, for each of the subjects, that allows students to understand the content once they're alone.

The work in the classroom is organized around the activity sheets, which involves all the subjects addressed in the course. These sheets contain the tasks that students must carry out, as well as all the necessary activities that provides all the stages of the student's autonomous work. The work is done in the classroom so that the teacher can answer the eventual doubts, as the students progress on their studies. If necessary, additional work outside of the class must be done, in order to complete the activity. The solution of them will be available after the deadline.

The activities involved in this methodology have all the necessary materials available. However, the students are free to use as many sources of information as they need, in order to develop their personal sense of initiative.

Even though the activity sheets are made in groups, they must be delivered individually to the teacher. Due to the elevated number of work submitted by the students, the teacher will only correct 2 or 3 from each of them.

With this methodology, the teacher ends up answering more doubts than before, passing from 3 or 4 questions to 50, per class. Of course when different groups have the same doubt, then there is a joint explanation.

It's intended with the application of this active learning methodology to maximize students' dedication, supervising their autonomous work.

Innovación Educativa Implementación de la Metodología SABER

Química / Física / Ingeniería Instituto Politécnico Superior de Viseu, Portugal

Tema:
Enlace Químico

Funcionamiento del Aula

- Se trabajan las Hojas de Actividad (HA), en grupos de entre 3 y 4 alumnos. El calendario de todas las HA que componen el curso (entre 10 y 15) es público y conocido desde el inicio del curso.
- Los alumnos redactan un dossier individualmente, que contiene las respuestas a las cuestiones que plantea cada Hoja de Actividad.
- Las respuestas a las cuestiones se deben obtener de lo que se ha consultado: clases, ejercicios o prácticas anteriores, apuntes, libros, y muy aconsejable, la red. Por tanto, *no se pueden hacer hipótesis sin contrastarlas*.
- Toda respuesta *debe incluir la fuente* de donde se ha obtenido la información.
- Las lecturas y las cuestiones que incluye la HA se trabajan en grupo. Las argumentaciones necesarias se discuten entre miembros del grupo, y también entre diferentes grupos.
- Todo aquello que no se entienda, tanto de las lecturas, de las cuestiones, así como de las fuentes de información externa, debe ser preguntado al profesor.
- La pregunta forma parte del proceso de aprendizaje: en ningún caso las preguntas servirán como criterio de evaluación. Es necesario por tanto traducir a pregunta CUALQUIER duda que pueda surgir, mientras se trabajan las HA.
- Las respuestas a las Hojas de Actividad se entregan a través del Campus Virtual, antes de la fecha y hora establecidas.
- *Tres días después de la fecha límite*, aparecen las respuestas del profesor, a las cuestiones de las HA.
- Los alumnos deberán completar sus respuestas, detallando explícitamente las similitudes y diferencias entre sus respuestas y las del profesor, así como las causas de las diferencias. Una vez completadas, se entregarán de nuevo a través del Campus Virtual, antes de una nueva fecha límite.
- *Una semana después de la segunda entrega*, los alumnos deberán responder a un (corto) cuestionario *on-line*, que evaluará el contenido de la HA. Estos cuestionarios se responderán fuera del horario de clase, excepto en los casos individuales que requiera el profesor, que se harán presencialmente.
- Si es necesario, la finalización de las HA deberá hacerse fuera del horario de clase. También se llevará a cabo fuera del horario la segunda versión de las HA, que incluye el análisis y comparación de las respuestas con las del profesor.

Educational Innovation
Implementation of SABER Methodology
Chemistry / Physics / Engineering
Instituto Superior Politécnico de Viseu, Portugal

Topic: Chemical bond
Function of the Classroom

- The Activity Sheets (AS) are made in groups of 3 or 4 students. The schedule of all ASs, that compose the course (between 10 and 15), is public and known since the beginning of the course.
- The students write an individually report, which contains the answers of the questions raised by each activity sheet.
- The answers of the questions should be obtained accordingly to what was consulted: classrooms, exercises or previous practices, notes, books, and highly advised, the internet. Therefore, hypotheses cannot be made without being supported by them.
- All the answers should include the source of information, where they were obtained.
- The reading and questions, that the activity sheets include, are worked in group. The necessary arguments are discussed between members of the same group, and also between the different groups.
- Everything that is not understood, reading, questions and sources of external information, must be requested from the teacher.
- The act of questioning is a part of the learning process: in any case the questions will serve as an evaluation criterion. It's, therefore, necessary to translate ANY of them that may arise, while working on AS.
- Before deadline, the answers to the activity sheets are delivered through the Virtual Campus.
- Three days after deadline, the teacher's answers of the AS will be available.
- Students should complete their answers, explaining in detail the similarities and differences between them and the teacher's answers, as well as the causes of those differences. Once completed, they will be delivered, again, through the Virtual Campus, before the new deadline.
- A week later after the second delivery, students must answer to a (short) on-line questionnaire, which will evaluate the content of the AS. These questionnaires will be answered outside of the classroom, except in the individual cases that the teacher requires, which will be done in person.
- If necessary, the completion of the AS should be done outside of the classroom. The second version of them, which includes the analysis and comparison between answers, will be also carried out after the working hours.

ENLACE QUÍMICO

En este tema trataremos las sustancias químicas y sus propiedades. Explicaremos que estas propiedades se deben al tipo de enlace químico que se establece entre ciertos átomos que componen la. Veremos que se pueden clasificar estos enlaces en tres grandes tipos: covalentes, iónicos y metálicos. Finalmente, aprenderemos a predecir propiedades de las sustancias, según la posición de los átomos constituyentes en la Tabla Periódica de los elementos.

Iniciemos el tema con una reflexión, para situarnos:

Cuestión 0: *¿Cuántos elementos químicos diferentes hay?
¿Cuántas sustancias químicas diferentes hay?*

Sabemos bien que toda la materia que nos rodea, ya sea el aire que respiramos, las paredes del aula, las mesas, sillas, plantas, los seres humanos, ... está formado por átomos.

Cuestión 1: *Si todo está formado por átomos, ¿por qué la materia se manifiesta en formas, colores y texturas tan diferentes? Haz una hipótesis sencilla.*

Por ejemplo, comparemos un **objeto de hierro** con unos **granos de sal de cocina**, tal como se muestra en estas imágenes:



El *Hierro* es una sustancia pura, compuesta por un único elemento químico, de símbolo *Fe*. En cambio, la sal común es una combinación de dos elementos, el cloro, *Cl*, y el sodio, *Na*, conocida como *Cloruro de Sodio*, *NaCl*.

la sal si lo golpeamos con un martillo, y también se disuelve en agua, convirtiendo el líquido en conductor de la electricidad.



Más datos. Combinaciones parecidas dan compuestos parecidos. Por ejemplo, cambiando el cloro por el bromo, y el hierro por otro metal de transición, se obtienen sales granulosas muy equivalentes a las anteriores.

Otro aspecto, muy interesante, es que **la forma** mediante la cual obtenemos un determinado compuesto no es importante. Por ejemplo, el cloruro de hierro se puede obtener también a partir del tratamiento de **óxido de hierro, Fe_2O_3** , y **ácido clorhídrico, HCl** . Se obtiene nuevamente $FeCl_3$, con aspecto idéntico al sólido anaranjado anterior.

Más de trescientos años de investigación, dedicados al estudio de millones de sustancias, han permitido coleccionar y clasificar los compuestos en grandes familias. Posteriormente, las hipótesis sobre la naturaleza atómica de la materia, y el estudio de los electrones de valencia en los átomos, han permitido presentar una visión global, relativamente sencilla, sobre la forma mediante la cual los átomos se enlazan entre sí.

La síntesis y clasificación de las propiedades fisicoquímicas principales, ha llevado a las siguientes clases de compuestos:

- Compuestos **iónicos**: sustancias como el cloruro de sodio, yoduro de potasio, cloruro de magnesio... compuestos de **aspecto cristalino, frágiles** y con **elevados puntos de fusión y ebullición**. Son solubles en agua, pero no lo son en disolventes orgánicos como el benceno. En estado sólido no conducen la electricidad, pero sí lo hacen en disolución, o cuando funden y pasan al estado líquido. Los compuestos consisten, normalmente, en combinaciones binarias (de dos elementos) de elementos que están en los extremos de la Tabla Periódica.
- Compuestos **covalentes**: se trata de sustancias como el oxígeno, el hidrógeno, el nitrógeno, el dióxido de carbono, el agua, el amoníaco, ... muchas de las cuales son **gases a temperatura ambiente**, y se pueden calentar bastante sin descomponerse. No se disuelven, o lo hacen muy poco, en agua, pero son mucho

más solubles en benceno. Muestran **puntos de fusión y ebullición bajos**, y no conducen la electricidad en estado líquido.

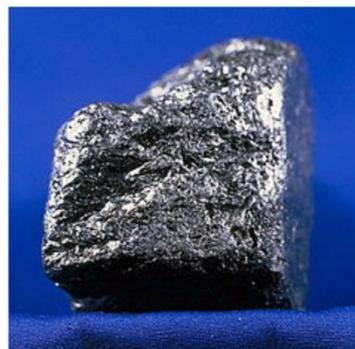
- Compuestos **metálicos**: son sustancias que conducen bien el calor y la electricidad, y como sustancias puras **constituyen más de tres cuartas partes de los elementos químicos**. Tienen puntos de fusión elevados, aunque en un intervalo amplio. La mayoría de los metales brillan, y son fácilmente deformables, y por tanto dúctiles y maleables.

Cuestión 5: *Construye una tabla, que incluya las propiedades de las tres familias de compuestos expuestas en los párrafos anteriores.*

Cuestión 6: *Propón una explicación, en términos de los electrones de la última capa atómica, para los tres tipos de enlace.*

El diamante y el grafito

Si la composición de las sustancias nos lleva a propiedades muy diferentes, **la manera con la que los átomos se enlazan entre sí también afecta a estas propiedades**. Un ejemplo muy ilustrativo viene dado por los **diamantes** y las minas de lápiz, es decir, por el **grafito** que las componen. El diamante y el grafito son dos sustancias formadas esencialmente por un solo elemento químico, el **carbono**. Y, en cambio, no pueden ser más diferentes. El primero es una piedra preciosa, y **el compuesto más duro conocido**, mientras que el grafito sirve, entre otros usos, per escribir, gracias a que es **exfoliable**, es decir, se puede separar fácilmente en láminas delgadas.



Cuestión 7: *Busca una explicación para las diferencias entre el diamante y el grafito, respecto los enlaces entre los átomos de carbono. ¿Cuál de las dos formas es más estable, a temperatura y presión ambientales?*

Activity sheet – chemical bonding (EN)

CHEMICAL BONDING

This topic will address the chemical substances and their properties. We will explain that these properties are due to the type of chemical bond, which is established between certain atoms that compose it. We will see that these bonds can be classified in three main types: covalent, ionic and metallic. Finally, we will learn to predict the properties of substances, depending on the position of the constituent atoms in the periodic table of the elements.

We will start the subject with a reflection:

Question 0: How many different chemical elements are there? How many different chemicals substances are there?

We well know that everything around us, wants the air that we breathe, the walls of the classroom, tables, chairs, plants, humans, ... are constituted by atoms.

Question 1: If everything is constituted by atoms, why is the matter manifested in such different shapes, colors, and textures? Make a simple hypothesis.

For example, let's compare an iron object with a few grains of cooking salt, as shown in the following pictures:



Iron is a pure substance, composed of a single chemical element, Fe. In contrast, salt is a combination of two elements, chlorine (Cl) and sodium (Na), known as Sodium Chloride, NaCl.

The properties of substances

The different substances which constitute the world have different **properties**. For example, iron is gray and shiny, and can have almost any shape. On the other hand, the salt is white, slightly transparent, and can not be molded.

Of course, both substances are **solid**.

We also know that hitting an **iron block** with a hammer, it resists or slightly deformed. This property of iron is the one used by the blacksmith to make many utensils. Instead, **if we submit a grain of salt to the same impact of the hammer, it breaks into hundreds of smaller fragments:**



Question 2: Research in the literature why iron and salt behaves so differently in response to the impact of the hammer.

On the one hand, it is known that **iron conducts electricity**. In contrast, salt it is not conductive, as well as pure water.

Question 3: Draw and describe the necessary device, which contains a battery and a lamp, to check if a certain substance conducts electricity.

However, salt is particular: if we dissolve it in water, the resulting mixture conducts the electricity. That is, the mixing of two non-conductive substances leads to conduction. Iron, on the other hand, is not dissolved in water, nor does it cause water to conduct electricity.

Question 4: Research in the literature the changes that occur, **at molecular level**, when a solid salt dissolves in water.

The properties that characterize the substances, and which show how diverse their behavior may be, are many: **density, hardness, malleability, elasticity, melting temperature**, ... However, there are so many chemical elements and so many different chemical substances, that it seems difficult, if not impossible, to extract some pattern or rule of any kind: is it really possible to classify chemical compounds according to their properties?

Properties and composition

It is difficult not to reason that properties depend on the composition of substances.

Already the old thinkers had noticed this possibility. The Greek philosophers, for example, had proposed that the properties of substances depended on the ratio with which the four primordial substances, the water, the fire, the land and air combined.

Obviously, the vision of the old ones was surpassed by the accumulate knowledge. And that we cannot make a hypothesis without having a good database, obtained analyzing different substances and observing as its properties is modified for the mixture, heating, milling, distillation, etc.

Let us come back to our initial substances. The iron and salt have different aspects and properties because they are substances composed of different elements: The same iron for the first, and chlorine and sodium for the second. We must include, despite, more cases. For example, the salt, which is a white solid, can be obtained from the direct combination of **sodium**, which is a **metal solid** when pure, with **chlorine**, a **green colored gas**:



We have, then, that the **union of a metallic solid and a gas gives rise to a solid white**. It is therefore a very relevant transformation, if we consider the initial aspect of the constituent substances as a starting point.

Let us go some more. Iron also gives rise to a transformation comparable to the case of sodium plus chlorine: if iron, the metal solid, is mixed with chlorine, a substance with very similar properties to the table salt is obtained. The **iron chloride** obtained from the chemical formula FeCl_3 is a granular orange solid with properties very similar to sodium chloride, except in color: behaves just like salt if hit with a hammer and also dissolves in water, converting the liquid into a conductor of electricity.



More data. Similar combinations give similar compounds. For example, when exchanging chlorine for bromine and iron for another transition metal, granular salts very equivalent to the above are obtained.

Another very interesting aspect is that **the way** we get a certain compound is not important. For example, iron chloride may also be obtained from the treatment of **iron oxide, Fe_2O_3** and **hydrochloric acid, HCl** . It is obtained again FeCl_3 , with the same appearance as the orange solid.

More than three hundred years of research devoted to the study of millions of substances allowed collecting and classifying compounds in large families.

Subsequently, hypotheses about the atomic nature of matter and the study of valence electrons in atoms have allowed us to present a relatively simple overview of how atoms are linked together.

The synthesis and classification of the main physicochemical properties led to the following classes of compounds:

- **Ionic** compounds: substances such as sodium chloride, potassium iodide, magnesium chloride ... compounds with **crystalline appearance, fragile** and **with high melting and boiling points**. They are water soluble, but are not in organic solvents like benzene. In a solid state, they do not conduct electricity, but do it in dissolution, or when they fuse and pass into the liquid phase. Generally, components consist of binary (two-element) combinations of elements that are at the ends of the Periodic Table.
- **Covalent** compounds: they are substances like oxygen, hydrogen, nitrogen, carbon dioxide, water, ammonia... many of them are **gases at room temperature** and can be heated without decomposing. They do not dissolve, or do it almost anything in the water, but are much more soluble in benzene. They show points of **low melting and boiling**, and they do not lead electricity in the liquid phase.
- **Metal** compounds: substances that conduct well heat and electricity, and as pure substances, **constitute more than three quarters of the chemical elements**. They have high melting points, although in a wide range. Most of the metals shine, and they are easily deformable and therefore ductile and malleable.

Question 5: Construct a table, which includes the properties of the three families of compounds exposed in the above paragraphs.

Question 6: Propose an explanation, in terms of electrons of the last atomic layer, for the three types of bonds.

Diamond and graphite

If the composition of the substances leads to different properties, **the way of how atoms bond together also affects those properties.**

An illustrative example is given by diamonds and pencil mines, that is, by the graphite that composes them. Diamond and graphite are two substances formed essentially by a single chemical element, **carbon**. And, instead, they cannot be more different. The first one is a precious stone, and the **hardest compound known**, while graphite serves, among other uses, to write. Because of this, it is exfoliating, in other words, it can be easily separated into thin sheets



Question 7: Find an explanation for the differences between diamond and graphite, in particular the bonds between the carbon atoms. At normal temperature and pressure, which form is more stable?

Annex 6 – Workshop certificate



Learnin's Creatin'

SAICT-POL/23394/2016



CERTIFICATE

Is presented to _____ for having participated in the **“Let’s make good academic performance possible”** workshop, under the “Learnin’s Creatin’ - Addressing SI&TD problems, decreasing dropout and improving student outcomes, using active learning methodologies” project, that took place September 13th, 2017 at the School of Technology and Management, Polytechnic of Viseu.

João Luís Monney de Sá Paiva
(Project PR)

