THE EUROING PROJECT AND HIGHER EDUCATION IN EUROPE.

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I. Project Background.

In the 1980s, internationally renown professors and researchers forewarned that by the end of the century, there would be an important reduction in market demand for traditional materials (mainly in the metal sector). According to experiments carried out, the void that would appear in the markets would be filled with what was then an abstract although new and innovative: "*new materials*" . Nowadays, the meaning of 'new materials' can be affirmed as referring to that product which is equivalent to the traditional material but with improvements and at a lower price: 50% of steel now used were unknown in 1985.

In the text by Professor Ashby (1), reference is made to a graphic, Figure 1, in which the relative importance of materials used since time before Christ (10,000 years B.C.), until 2020 was foreseen. In 1960, it was said that for every hundred tonnes of material used by Man, 82% corresponded to metallic products while the rest (the remaining 18%), will be objects made with ceramics, polymers or compound materials. In 2005, the following results were found: of every hundred tonnes of material produced, 39% would be metallic while ceramics, polymers and compounds would make up 18%, 26% and 17% respectively.

If we take as an average 3% as the increase rate in the consumption of materials in the world from 1960 to 2005, then the 100,000 tonnes of structural material corresponding to 1960 (reference year for the calculation) become 378,000 tonnes in 2005 (formula of compound interest). Identifying the value of importance relative to materials with their participation percentage in the design and structure constructions, in 1960, for every 100

tonnes of material used, 82 will be used in the construction of equipment with components of a material kind. In 2005, applying the increase rate in the consumption of materials, of the 3%, 278 tonnes were needed of which only 147 tonnes were identified with the use of metallic qualities. That is, that the projection of metallic products growth between 1960 and 2005, according to Prof. Ashby, was 79%, while real numbers indicate that in 1960, the production-consumption of metals was of 436 Mt, while in 2005 it reached a total 1331 Mt: the corresponding increase rate in this case was 205%. The relative importance in 2005 of metallic materials that is closest to reality would be that in which a weight of 66% could be attributed instead of 39%, which would be the result according to Ashby (1).

In western universities, these predictions have often led to the practical disappearance of subjects related to the Iron and Steel Engineering in academic programmes. Regarding Spain, only one group of professors who lead the Research Group on Iron and Steel, Metallurgy and Materials in Oviedo University (http://www.uniovi.es/sid-met-mat), have publicly maintained at all times theses contrary to the hypotheses that have been given by a majority over recent decades of the last century. It is true that the country (Spain) needs forward-thinking research groups in different fields of knowledge, but without abandoning those that have existed traditionally for regarding them as something obsolete. On another point, lecturers and researchers should leave to intellectual maturity to discern that not all that glitters is not gold: The Guggenheim Museum in Bilbao has 44 tonnes of titanium on its façade, held together by a 4,300 tonne steel structure, invisible to the visitor.

Nevertheless, in countries which in 1980 were under the influence of the old Soviet Union, the situation of Metallurgy Engineering has habitually been very different. For example in Krakow, Poland, the Mining and Metallurgy Academy (AGH) was founded in 1922 which has since become the University of Science and Technology of Krakow where, since 1993, three departments in the fields of metallurgy and materials have been running:

Kommentar [Y1]: Krakow?

The Department of Metallurgy and Materials; the Department of Fusion Engineering and the Department of non-Ferrous Metals. In the academic year 2004-5, the number of students who enrol in first degree studies in the Departments at Krakow were 1473 while the number of students in Doctorate Programmes related to Metallurgy Engineering and Materials were 91 (2).

Since 2004, the Spanish Union of Iron and Steel Companies (UNESID) and Oviedo University participate in the development of the research project for the European Leonardo Programme called: EUROIng. *Postgradual qualification for European foundry engineers. Re: DE/04/B/F/PP 146 108.* The objectives are within the same framework as the EU (Germany in particular), of offering postgraduate level degree titles in the field of Metallurgy Engineering within the EU.

II. University Education in the European Union.

For the reader to understand and form his/her own opinion of the situation that is presently being experienced in the European University Education, we believe we must define as clearly as possible what the present situation is like regarding university education and where the valuation criteria belonging to the reform agreed in the Bologna Protocol is leading us. At present, university degrees that are offered in the European Union is operating under the application of the following criteria (3):

1. The value of the academic activity denominated as credit: equivalent to 10 hours of class attendance whether theory or practical.
2. For one academic year, a maximum of 75 credits is being had a normal, (750 class hours, theory or practical). A EUROIng programme at a Technical Engineering level would mean an approximate three or four years of education which equals 225 credits (2,250

class hours). One academic year would correspond to the corresponding education received for two terms: first and second.

3. A EUROIng programme at a level of Superior Engineering, will have a minimum of 375 credits to employ for a period of four (eight terms) to five years (ten terms).
4. During an academic course, the number of class weeks are usually 30. During each week, the number of class hours are 25, resulting in 5 per day.

According to the Bologna Protocol which regulates the new framework for Higher Education in the European Union, it establishes a new criteria with which to evaluate academic activity. It adds to theoretical and practical hours, those which the student may need to understand the subjects: the ECTS. The equivalence between attendance credits presently in vigour and the Bologna ECTS are approximately two: 1,0 Credits of the present system = 2,0 ECTS. On another point, degree university studies, following the Bologna Declaration, will have a 240 ECTS weighting (three to four years) and will be necessary for the student to access postgraduate education.

The EUROIng Project leads us to reflect upon the characteristics that a Foundry Engineer must have within the EU university education: choosing wither a degree or postgraduate programme. The undersigned agree on the postgraduate option, on the following grounds:

1. Defining a postgraduate programme would fit perfectly in the framework established by the Bologna Protocol which aims at developing at a European Union level, a three to four year basic Engineering Degree, having a total academic value of 240ECTS. A basic and generalist profile, such as that described by the Bologna declaration, would be complementary with a year and a half postgraduate degree in the various fields of engineering: Metallurgy, Materials, Foundry - Casting and Non-Ferrous.

2. Such a specific degree programme as that of Fusion Engineer with 240ECTS might have difficulties in entering the work market especially in EU countries which have low rates of fused materials of a ferrous or metallic nature.
3. A programme for specialists – worker-man of Foundry who can develop their work and professional competence efficiently in production control and management tasks, could be proposed with solid guarantees for success outside the university arena: Professional Training Schools.
4. It is very likely that a Fusion Engineer degree programme with 240ECTS might be insufficient with which to respond to the needs of innovation and technological change which is presently being considered in European small and medium sized industries.
5. It might be possible for private business bodies or non-state universities to take advantage of the programme that is being elaborated for the Fusion EUROIng at postgraduate level and try to finalise it in the future in the different countries in the EU. The normalisation of the programme could be yearly (as in the case of Germany), or biannual – triennial (which might be the situation of Spain). In Spain, there is an Association of Fusion Engineers Spanish Federation which, amongst other activities, edits "**Fundidores**" magazine: http://www.metalspain.com. The precursors of the initiative can be found in the Solders European Federation which offers and credits postgraduate courses in Welding Engineering in different European countries (in Spain: the coordinated organisation is called CESOL, Spanish Welders Association and Union Technology, http:// www.cesol.es).

Kommentar [Y2]: Qué quieres decir con maestros, que enseñan o que dominan su campo?

III. Analysis of the situation in Spain.

At present, the situation of postgraduate Spanish Engineers (Higher Technical Schools), without reaching the levels of specialisation that the EUROIng aims to achieve in Fusion,

constitutes a good springboard from which to structure the postgraduate EUROIng programme.

Undoubtedly, the Spanish degree that most closely matches the requirements of the postgraduate EUROIng is Mining Engineering (Madrid, Oviedo and Vigo) with the intensification in Metallurgy and Materials. In particular, the degree in Mining Engineering from Oviedo University would need between 100ECTS and 150ECTS to reach the objectives of the postgraduate EUROIng. Nevertheless, at present, any of the Higher Spanish Engineering degrees could adapt to the EUROIng programmes with 200-250ECTS.

On another point, the present situation of Spanish Higher Engineering degrees might change radically once the Bologna Protocol is in vigour. It is very probable that the postgraduate Mining Engineering degree with intensification in Metallurgy and Materials will disappear from the Spanish University. Equally, the possibility that the Spanish University offers a postgraduate degree equivalent to the Fusion EUROIng, can be completely discarded. Therefore, in the case of Spain, what educational possibilities can it offer? In the opinion of the undersigned, there are two fundamental alternatives that can be proposed:

a) Those initiatives promoted by Business Associations of the UNESID type.

b) Those which Professional Engineers Association or Private Universities.

Even if the the possibilities that Professional Associations and Private Universities can offer have been until now rather uncertain, the undersigned are moderately optimistic regarding educational opportunities that can be created in Business Associations. The needs of the Spanish market for a postgraduate Metallurgy and Materials Engineer of a wide spectrum with the possibility to work in Fusion, Iron and Steel, Non-Ferrous Materials and Non-Ferrous Extractive – Transformation – Metal Working Metallurgy is calculated at being around 20graduates/year, according to surveys. The academic level of candidates that

will be subjected to the requirements of the Bologna Protocol that will be implanted in the Spanish University by the end of the decade. Nevertheless, by means of choice entrance exams, the most appropriate people will be accepted. Equally, basic complimentary subjects around 100ECTS could be agreed upon in mathematics, physics and chemistry for the preselected students for the postgraduate course in Metallurgy and Materials. The postgraduate classes would extend over two years, 150ECTS/year. Professionals who have received their education in this way could respond to the market demands not only regarding requirements demanded by professional bodies related to managerial posts but also to promote the development in the continuous improvement and innovation of processes and products in the small and medium-sized companies.

IV. Conclusions

The needs proposed by the EUROIng project are the result of the abandonment – in a majority of western universities – of fields related to Metallurgy Engineering that were put into practice since the last decades of the XXth century.

The definition of European academic programme of a postgraduate level degree in Fusion Metallurgy Engineering, could be achieved with the EUROIng Project. Equally, the fields and disciplines that must be fulfilled in university degrees according to the Bologna Protocol can be defined with the Project in order for them to adapt to the postgraduate EUROIng.

If levels of competency required by a company reach the follow-up of norms and instructions that have be perfectly defined and laid out, university degree education or non-university professional education that is equally specialised would be sufficient. Otherwise, if the required levels of professional competency match the management, innovation or the

development of processes and products, the minimum degree eligible will be that which corresponds to a postgraduate qualification.

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Relation of Figures

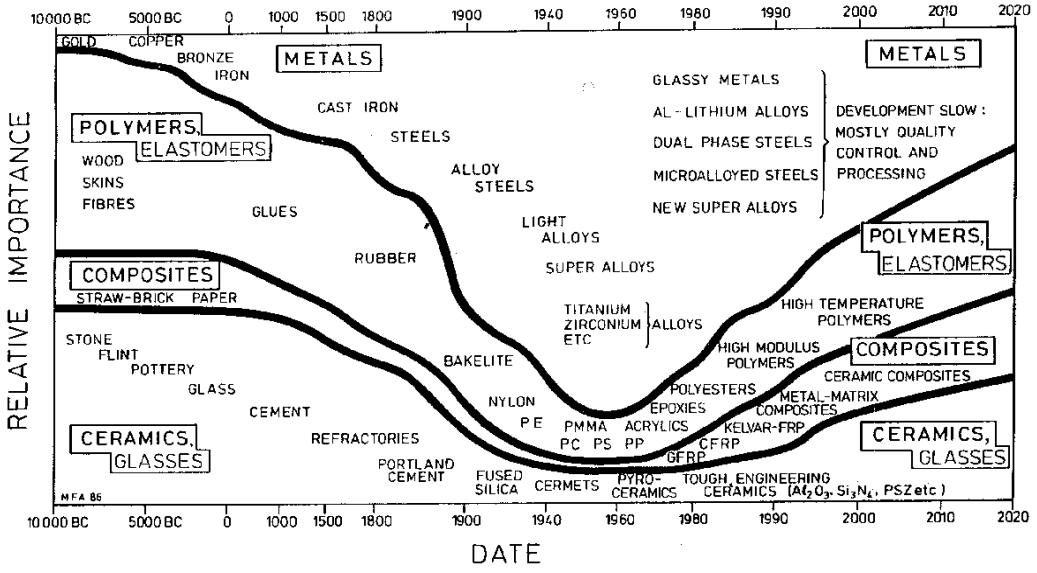

FIG. 1.1 The evolution of engineering materials.

Figure 1.- Evolution of engineering materials (according to M. F. Ashby, 1992: page 3).