Porcelain (Vitreous) Enamel:
European and International Standardization

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Abstract

In the latest 25 years Porcelain (Vitreous) Enamelling has been a very active coating branch in the field of European and international standardization.

An historical review of the international standardization creation process is described. Dominant contributing organizations and meeting / contact forums created for this process were and still are: (i) The European Enamel Authority (EEA)
(II) the European standardization committee on enamel CEN/TC262/WG5 and
(III) The international standardization committee on enamel ISO TC107/WG2.

In addition following aspects will be treated:
* Why has all this extensive work on quality requirements and enamel standards been done?
* Some porcelain (vitreous) enamelled products and their relations with standards will be shown.
*Assurance of product conformity and (EEA) certification(s)
* Porcelain (Vitreous) Enamel industry can face the future.

Introduction

In the latest 25 years Porcelain (American terminology) and Vitreous(English terminology) enamelling has been a very active coating branch in the field of European and international standardization in comparison with many other (coating) industry branches:

History

More than 25 years ago (1985) "**national"** standards and/or quality requirements on porcelain (vitreous) enamel were ruling in the different European countries and also worldwide. This was also the time that some **international** cooperation did start with respect to standardization. For instance: Since 1985 The Netherlands and Belgium did work out together a broad series of common quality requirements in "Stichting Email (E: Enamel

Foundation) The Netherlands - Belgium". These quality requirements were the industry standards in both countries.

Because many enamelling companies in Europe were exporting a large deal of their turn-over outside their home country many industrial enamellers became interested in international standards rather than national standards. Some people active in various national standardization bodies came together and grounded in 1989 at PolyVision (Alliance) NV in Belgium the **European Enamel Authority (EEA)**; representing enamel organizations from 5 different countries: Germany, England, Belgium, The Netherlands and Austria. : Starting from available quality requirements and standards mainly coming from the "Technische Ausschuss DEZ (G)" and "Stichting Email (B+N)" ,added with standardization work from Great Britain, a EEA quality requirement handbook was composed and became the common industry standard for enamel products in these 5 countries. Since then Czech Republic joined the organization. The fourth edition of the EEA handbook is planned to appear in 2012. Quality requirements for more than 25 vitreous enamelled products are described in very detail in this handbook, together with the test methods being used. This EEA handbook (also available on CD-ROM - www.european-enamel-authority.org/en) is according to my opinion the most detailed and elaborated international handbook available worldwide for describing in depth the quality level of vitreous enamelled products.

Mainly since 1991 a rapidly increasing amount of EN (European Norm) standards were created within CEN ("European Committee for Normalization", www.cen.eu ,). The reason for the creation of these EN standards was twofold: 1. Avoiding protectionism within the European Community by national standards 2. Increasing the competitiveness of Europe. This happened also to the European porcelain (vitreous) enamel industry:

In addition to the EEA initiative (1989) mentioned above, a working group on porcelain (vitreous) enamel was founded 5 years later (1994) within CEN i.e. **CEN /TC262/WG5** (TC stands for technical committee and WG stands for working group), representing not only the above mentioned 5 European countries but also all other European Community countries . CEN/TC262 is the European normalization committee dealing with coatings. CEN/TC262/WG5 reports to CEN/TC262. Dominantly starting from approved EEA quality requirements, several enamel standardization topics were discussed between all active EN countries, drafts circulated and finally approved following the standard EN voting procedures. This all led to about 15 EN (European Norm) standards on porcelain enamel. Within Europe EN standards are superseding national standards covering the same topics. Such national standards need to be withdrawn within a limited time after approval of the superseding EN standard.

In contrast to EN standards, ISO (Industrial Standard Organization, 162 member countries, www.iso.org) standards have no obligation character in Europe, neither in the world, but have a voluntary character. However, an ISO standard can be taken over by a country as national standard. Most porcelain (vitreous) enamel ISO standards are recent, but there are a few exceptions. For instance the standard on scratch resistance ISO 15695 was first discussed out in a Belgian – The Netherlands working group, leading to the creation of NEN 2713. This standard was then directly discussed in an ISO subcommittee with the final result of creating ISO 15695 in 2000. This was all before CEN TC262/WG5 created its first international approved standard in 2003. From that moment on most actual enamel ISO

standards did follow the discussion, refinement and approval route of EEA quality requirement, to EN standard, then ISO standard and then EN-ISO standard.

The difference between ISO and EN-ISO standards for countries of the European Community is that ISO standards are voluntary, while once approved by national voting to EN-ISO standards they are becoming harmonized standards, hence obligatory for all Member States while national standards covering the same topic need to be withdrawn.

CEN/TC262 ("coatings") is the parent committee of CEN/TC262/WG5 ("enamel"). Similarly ISO/TC107 ("coatings") is the parent committee of **ISO/TC107/WG2** ("enamel").

For CEN (Central Secretariat: Brussels, Belgium) and ISO (Central Secretariat: Geneva, Switzerland) standards, there exists a **Vienna Agreement.** For Porcelain (Vitreous) Enamel standards, CEN takes the lead. The Agreement on technical cooperation between ISO and CEN (Vienna Agreement) is an agreement on technical cooperation between ISO and the European Committee for Standardization (CEN), formally approved in 1991 in Vienna. One of the goals was to avoid double work on standardization in CEN committees on the one side and ISO committees on the other side. So within ISO (secretariat and presidency of ISO/TC107 moved to Korea) CEN TC262/WG5 (chairman and secretariat: GB) takes the lead and is meeting regularly on EN, ISO and EN-ISO standards in the field of enamelling.

Actual Situation

What's the actual situation of European and international quality requirements and standards on porcelain (vitreous) enamel?

1. There are at the moment about 30 up to date quality requirements for enamelled articles available from the European Enamel authority (www.european-enamel-authority.org/en). This EEA handbook, now elaborated to its third edition is to my knowledge till today the most elaborated compilation of detailed and updated quality requirements for the broadest range of industrial enamelled products available in Europe and worldwide.

2. Please find in table 1 below the actual list of EN, ISO and EN-ISO standards on porcelain (vitreous) enamel:

see Table 1

Why?

Why has all this elaborated work on quality requirements and enamel standards been done?

1. Many companies are exporting a large part or a major part (for instance PolyVision Belgium 98%) of their turn-over outside their homeland. So international standardization is a need or a must. Certainly for the European community where EN standards are superseding national standards.
2. Porcelain (vitreous) enamel products are often outperforming in quality organic coated products. So product quality needs to be defined and standardized to provide enough customer service, confidence, as well as quality and lifetime assurance in this globalized world.

Dissemination Level

What's the dissemination level of this international work?

EN, ISO and EN-ISO standards are at present the world standards in the porcelain (vitreous) enamel industry worldwide. There are however two important exceptions: Japan and USA who are both relying dominantly on their own national standards and/or quality requirements. Leading sometimes to important differences for instance for adherence: category 1 is the best and category 5 is the worst in EEA quality requirements as well as in EN and ISO standards, while it is the reverse for the US and PEI (Porcelain Enamel Institute, USA) standards and quality requirements on this issue. However, also in these countries ISO standards start to become more and more introduced, for instance ISO 9001 (management system on quality) in USA.

Some porcelain (vitreous) enamelled products and their relations with standards:

As an example of the outperforming properties of porcelain (vitreous) enamel in different industrial areas, please find in Figure 1 a comparison with respect to scratch resistance according to ISO 15695 for whiteboard (EN-ISO 28762) applications. Note the difference of an order of magnitude between porcelain (vitreous) enamel on one side and organically coated materials on the other side. These results justify why PolyVision (www.polyvision.com) assures a life time surface warranty for their visual communication products (chalkboards, passive and interactive whiteboards).

Tunnel claddings / Architectural

Due to the high corrosion resistance, scratch resistance, abrasion resistance (automatic brush cleaning of sand and dirt in tunnels) and graffiti resistance; tunnel claddings, as well as metro, train, public sector and architectural claddings are an important market for porcelain (vitreous) enamel, both as light gauge (coil coated, less than 0.7mm steel thickness) or heavy gage (larger than 0.7mm) products . Technical quality requirements for these products are given in EN-ISO 28722.

The examples in Figures 2 and 3 meet all requirements mentioned in this EN-ISO standard. In addition the porcelain enamelled fluorescent lighting exit sign panels in Figure 3 meet not only the requirements of this EN-ISO-28722, but also the class A fluorescent light criteria mentioned in ISO 17398.

Chemical Vessels / Water Storage Tanks / Heat exchanger plates

Due to its high corrosion resistance (EN-ISO 28706 parts 1 to 5) enamel is used to a large extent for applications such as (products standards between brackets):

A. Reactor Vessels and Storage Tanks for the Chemical industry (EN-ISO-28721)
B. Regenerative enamelled and packed panels for air-gas and gas-gas heat exchangers (EN-ISO-28763 ; Figures 4a and 4b)
C. Architectural panels (EN-ISO-28722; Figures 2 and 3)
D. Water storage tanks (EN-ISO-28765; Figure 5)

Besides chemical resistance, the closeness of the surface (open pores, discontinuities) plays an important role for these applications:

No open pores are allowed at all for application A, in contrast to applications B, C and D. For exterior architectural applications (EN-ISO 28722), it is sufficient to limit the amount of open pores per m². A low amount is a proof of a small gas bubble structure, leading to a low open pore diameter at the enamel surface. Such pores get easily blocked by corrosion products as proven by thousands of enamel architectural projects worldwide. For storage tanks “discontinuities” in the coatings need to be avoided. This all leads to different test methods (EN 14430, ISO 2746, and EN-ISO 8289), conditions and criteria as revealed in the different product standards (see above) for these four industrial product groups.

Especially for heat exchanger plates (EN-ISO-28763) for electrical power plants, edge covering is important due to the very aggressive environment. A company active in this area did develop a software program predicting the lifetime of heat exchanger plates based upon the quantitative test results of the following test methods: acid resistance (EN-ISO-28706), open pore content (EN-ISO 8289) and edge covering (EN-ISO-28723).

Certifications

International quality requirements and Standards are interesting but customers are often asking for official certificates proving compliance to these products. Compliance towards the EEA quality requirements can be proven by obtaining a European Enamel Authority certificate. About 10 companies did achieve this certification which has to be renewed every three years. Proof of compliance has to be demonstrated every year.

Compliance to international porcelain (vitreous) enamel standards can also be demonstrated by “external audit reports” or certifications through approved accreditors.

Besides proof of product quality beyond any doubt (standards discussed above), also compliance to international management systems such as ISO 9001 (Quality), OHSAS 18001 (safety) and ISO 14001(environment) are becoming more and more important for assuring industrial management professionalism towards internal and external customers.

Taking into account the actual environmental problems with (i) high emissions of CO^2, (ii) energy shortage and (iii) materials shortage, “sustainability” is winning dramatically in importance the latest 5 years. Also in this area Porcelain (vitreous) enamel industry can play an important role as demonstrated by PolyVision in Belgium which is the first company in Europe having achieved a “Cradle to Cradle” (www.mbdc.com) certification. In addition more than 80% of the turnover of this company consists out of cradle to cradle certified products: e³ environmental ceramicsteel for chalkboards and passive whiteboards and the ēno interactive whiteboard, the only C2C certified interactive whiteboard in the market (Fig 6). The enamelled interactive writing surface of this board has a lifetime warranty on surface dry eraseability and also on the interactiveability of this surface.

In this sustainability context it is also interesting to mention that the first (PolyVision NV, Belgium) cradle to cradle certified company in Europe is a *porcelain (vitreous) enamelling company.*

Conclusion

In summary thanks to the expertise and the dynamism of many people coming out of the porcelain (vitreous) enamel world, excellent product standards and industrial standards for a very broad range of porcelain (vitreous) enamelled products have been created during the latest 25 years. Many of them became EN-ISO standards in the latest two years. This achievement together with good professional management can face the future for enamel industry, inclusive sustainability (3P's: respect for People, Profit and Planet) aspects which are and will become more and more important in coming years.

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