II - DEVELOPMENT OF THE QUALITY CERTIFICATION SYSTEM IN THE UNITED KINGDOM

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ABSTRACT

A brief history is given of ceramic tile standardization in U.K. and the introduction of quality certification. The role of quality assurance is outlined for dealing with starter materials, in-process measurements and final inspection and selection. Independent regular assessments of the quality control system, including records, and product testing are essential. Finally examples are given of some aspects of testing which illustrate variations from, and inadequacies in, test methods. The latter may hinder continued certification.

1. INTRODUCTION

The first national standards for ceramic tiles were published in 1945. BS1281 was the standard for earthenware wall tiles and BS1286 was the standard for clay tiles for flooring. Initially they only included dimensions and workmanship together with preferred sizes, colour, quality and descriptions of tile fittings. Prior to 1945 the size and quality of one manufacturers tile was not linked to another manufacturers tile except by the influence of the market, although the power of the user, then as now, should not be underestimated.

BS1281 was revised in 1958, 1966 and 1974 but BS1286 was only revised once, in 1974, although some amendments were made within a few years of the initial publication. After the last revision, BS1281 included requirements for preferred sizes, dimensional tolerances, surface quality, colour, size and position of spacer lugs, water absorption, crazing resistance, chemical resistance and impact resistance. The latter was a measure of the strength of the tile. The sizes and the coding system for tile fittings were also included. BS1286 had separate requirements for both single extruded tiles

(quarries) and dust-pressed floor tiles. The only characteristics consisted of dimensional tolerances, water absorption, colour and surface quality. Preferred sizes and tile fitting codes were also included.

Thus until the implementation of the European set of standards, published as parts of BS6431 in U.K., there were a number of characteristics that were not covered. Nevertheless some of those which have been introduced, for example linear thermal expansion, are now included for the information of users and are not intended as minimum quality targets. Other properties were effectively controlled by a combination of self-certification, competition between rival producers and the demands of the users. The strength, measured by modulus of rupture in the European standard, was one such characteristic.

The U.K. was one of the first countries to introduce a complete quality assurance system. Initially there was financial assistance from the government to enable firms to have the cooperation of independent consultants to develop quality assurance systems in accordance with BS5750. There are a number of certification authorities with the BSI kitemark system being perhaps the best known but in the ceramic area there is also the Ceramic Industry Certification Scheme (C.I.C.S.). This is a subsidiary of Ceram Research but it operates completely independently with a Governing Board having wide representation from government, the British Standards Institute, professional institutions, users and consumers. It has its own quality assurance.

2.- QUALITY ASSURANCE IN PRODUCTION

2.1.- GENERAL

The consultations which take place to enable firms to achieve the status of assessed capability in accordance with BS5750: Part 2, 1987, ISO 9002, EN29002, 'Quality systems - Model for quality assurance in production and installation' can be lengthy because the whole system of production has to be reviewed and in parts updated, to establish conformity.

The procedures have to cover:

(A) The control of purchased materials.
(B) The control of the manufacturing process.
(C) The control of in-process and final inspection, selection and testing.
(D) The provision of complete records as evidence of quality assurance.
(E) The feedback of customer complaints through sales to the quality department.

The responsibilities of quality control staff in relation to the total production/managerial personnel have to be suitably structured. A plan of this, details of the quality system and samples of the documentation are given in the Quality Manual. Since this Manual gives guidance for all levels affected by quality assurance it is of necessity a large document, possibly 1 00 sheets of typed A4 pages. The Manual includes training policy and complaints procedures.

Some features of the system are as follows:

2.2.- RAW MATERIALS AND OTHER STARTER MATERIALS

With the introduction of the C.O.S.H.H. regulations there should be no difficulties with unknown and potentially dangerous ingredients.

In the case of raw materials in general the manufacturer establishes the limits of analysis that apply to each raw material. The manufacturer receives a certificate with each batch supplied to show that the material is within the agreed analytical limits.

Starter materials which are preprocessed require a certificate of conformity. Again analysis data may be applied but more often the material, for example a glaze, may be identified by a catalogue number. The supplier may not wish to disclose fritting and mill-addition details and he therefore has to guarantee that the material is as ordered.

Even with certificates from the supplier the manufacturer may still wish to perform simple tests to check or amplify supplied information. This may for instance entail a rheological measurement of a clay slip.

2.3.- IN-PROCESS MEASUREMENTS

Wherever checks are made on materials and products or readings are taken from equipment, such as kilns, the staff have to be trained and full instructions should be available at the production position and records of the readings have to be kept. Copies of the instructions are in the Manual and records are collected and maintained centrally. Because of legal liability in U.K. the records are kept for six year. If potential defects that may relate to the quality of the tiles are not identified within this period the manufacturer ceases to be liable for prosecution in law.

Examples of in-process checks that may be made are:

Body slip (prior to spray-drying) - Nature of sieve residues / Silica content / Wet to dry contraction / On prepared specimens / Dry to fixed contraction

Biscuit tiles (in a two-fire process) - Facial dimensions and deviations / Thickness / Glaze pull (with a standard glaze) / Moisture expansion / Thermal expansion / Water absorption / Breaking strength

Glazed tiles - Facial dimensions and deviations / Thickness / Craze resistance / Glaze over-edge thickness.

These examples show that the quality assurance system demanded by the standard controls the total process and of necessity localised stop in production and/or product rejection may become necessary.

2.4.- FINAL INSPECTION AND SELECTION

The objective of all the training, controls, paperwork and feedback is to achieve tiles of the required standard. This is the standard the manufacturer has targeted, usually in excess of requirements for most of the BS 6431 limits. As with in-process checks the sampling procedure has to be established. All tiles are checked for one property however, that is surface quality. For twice-fired production strength may also be considered to be universally tested since all biscuit tiles are checked and those not conforming are rejected automatically during production.

At the final inspection and checking tiles are sorted into first quality, that is those conforming to BS6431 and those of second quality, those tiles just failing to pass, possibly as a result of a minor surface blemish. Second quality tiles are saleable and can be selected again and used for cut pieces by professional fixers. Tiles of poorer quality are scrapped.

The manufacturer does not check all the BS6431 properties but the full range for selected types chosen by the inspector of the certifying body is done by an independent test house on at least an annual basis. A manufacturer of glazed tiles is likely to check those that could be most prone to crazing and manufacturers of both glazed and unglazed tiles will ensure conformity with dimensional requirements. It is of course essential that spacer lugged tiles meet the tight tolerances demanded in BS6431. Accurate placing of the tiles could not otherwise be achieved.

3.- INDEPENDENT ASSESMENT

3.1.- CERTIFICATION INSPECTIONS

Inspectors from the certifying body, e.g. B.S.I. or C.I.C.S., visit on a regular basis and check all aspects of quality, procedures, and paperwork. This is done with great attention to fine detail so

that if one reading is missing from a particular record sheet the inspector will note it in his report. During the inspection he chooses boxes of selected types of tiles at random and seals the boxes. These are then delivered to the test house. All points of the inspector's report have to be followed and where necessary corrections are made in the system.

3.2.- PRODUCT CONFORMITY

The test house receives the sealed boxes and tests the tiles to all the relevant methods of BS 6431. The test house issues a report to the certifying body giving the results of test in accordance with BS 6431 and stating for each requirement whether the batch conforms or not. The manufacturer receives the report and any observations that may be necessary from the certifying body.

The U.K. has a system for accredited test houses and British Ceramic Research Limited is one of these under the National Measurement Accreditation Service (NAMAS). The test houses are themselves subject to regular inspections and there are some other aspects of the test house accreditation system that are similar to quality certification. Thus there is a manual showing staff structure, test methods, calibration and examples of paperwork. Full records have to be maintained and the general laboratory facilities have to meet certain minimum requirements. All samples and specimens for testing have to be coded when received and the codes become their permanent identification. It is also essential to have regular calibrations of test equipment and references with such calibrations being traceable back to a national calibrated source or a fundamental physical property.

4.- SOME ASPECTS OF TESTING

4.1.- IN-PROCESS FACIAL DIMENSIONS

In dust-pressed production it is essential to have a regular check of dimensions of tiles from the press. All dust is slightly abrasive and eventually the die cavities will become so large with wear that the resulting tiles will be over-size after firing. Knowledge of the drying and firing contractions is most critical for tiles that are to be vitrified during firing. The manufacturer has to establish the limit at which the press will be stopped and the die replaced.

4.2.- POTASSIUM PERMANGANATE STAINS

Experience with the European Standard test method for the stain resistance of glazed tiles showed that the requirement for the standard cleaning agent, and no other, be used to attempt to clean off potassium permanganate stains led to inappropriate failures. Typical cleaning agents found in most homes would easily remove the stain. The standard cleaning agent is therefore not typical of readily-available cleaning agents and the test method required amendment. In the U.K. a special notice had to be given by the certifying body to clarify the position with regard to tiles which failed strictly in accordance with the test method.

4.3.- THERMAL EXPANSION

A similar problem arose with A1 products because the particular European Standard, EN121, included a low limit for thermal expansion and an exceptionally well vitrified quarry tile failed because the thermal expansion was below the limit. In this case the certifying body accepted the assurance of the test house that the apparent failure was of no significance. The product standard for A1 tiles was the first to be completed and it was subsequently realised that there was no merit in a lower limit for thermal expansion. Consequently AII, AIII and all B products have no set lower limit. Limits are unnecessary for this particular property since it is intended for information that the user may require rather than for defining quality by thermal expansion.

5.- CRAZING RESISTANCE

Glazed tile manufacturers in the U.K. have a long tradition of measuring crazing resistance of glazed tiles in a series of cycles of steam pressure, variously 401bf/in2 (0.27 N/mm2) or 50 lbf/in (0.34 N/mm2). Manufacturers have usually used one-hour cycles. Thus tiles could traditionally be classed at the factory as 8-cycle or 10-cycle tiles. This approach may be retained by manufacturers as a means of better control than simple application of EB105 requirements.

6.- PROPERTY REQUIREMENT THAT ARE NOT STANDARDIZED

Manufacturers of floor tiles, whether dust-pressed or extended, are aware of requirements by users for adequate coefficients of friction. British Ceramic Research Limited has provided the means of measurement. The Tortus apparatus has shown that ceramic tiles generally have high coefficients in most conditions with a wide range of sliders. The only potential problems relate to smooth surfaces, such as some glazes in situations where there is lubricating material, e.g. water or dust. Potential problems can be overcome by surface texture and roughness. Although not standardised manufacturers have their tiles checked so that they are able to advise users and maintain their own set limits.

Metal release from glazed tiles has also been checked using a standard ISO procedure adapted by Ceram Research. This has not presented any problems although new designs of tiles that may be used on kitchen worktops are checked if necessary.

Another property with a Ceram Research in-house system of testing is impact resistance and checks are made of this occasionally, although usually a fixing system with a particular tile is tested rather than unsupported tiles.

None of these tests come under the quality certification/ accredited test system but manufacturers have to realise the requirements of specifiers that are not part of the formal quality assurance system.

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