Non-Combustibility of Building Products According to Different Classification Criteria

JADWIGA FANGRAT
Building Research Institute, Fire Research Department
Ksawerów 21, 02-656 Warsaw, Poland

MASASHI YOSHIDA
Building Research Institute, Tsukuba, 1 Tachihara, Ibaraki 305 0802, Japan

ABSTRACT

In the light of proposed European fire classification system for building products and national criteria used so far in Poland and Japan, the results of testing for the group of non combustible materials are presented and discussed.

1. INTRODUCTION

In the second half of 1999, the Technical Committee CEN TC 127 has decided to forward the newest version of classification document for building products [1] to so called Urgent Approval Path (UAP). But probably to some difficulties in preparation of SBI test, the formal deadline for the final version of the classification document has been postponed to the first half of year 2001 [2], while SBI standard is scheduled for December, 2002. With the one exception the final versions of the reaction to fire test standards necessary for the new CEN fire classification system are almost ready. Among them two known for years methods which are basis for classification of non-combustible products (EN ISO 1182 [3] and EN ISO 1716 [4]). These methods are also currently used as the national standard methods both in Poland and Japan. The aim of the work is to study and compare the possible fire classification obtained by means of different criteria proposed.

2. TESTING METHODS

Two standard methods have been used for experiments.

2.1 EN ISO 1182

The apparatus (Fig.1) consists mainly of the refractory cylindrical tube of the dimensions 150mm (height) x 75 mm (internal diameter) x 10mm (thickness), stand, stabiliser cone and draught screen. Furnace is electrically heated up to the temperature 750 ± 10 °C, measured by the furnace thermocouple of K-type. Cylindrical sample of 50 mm in height and 45 mm in diameter is placed in the furnace centre. The time of flaming combustion of the sample as well as the temperature rise of furnace, sample centre and sample surface are registered during the test by means of K-type thermocouples. Also mass loss of the sample is measured and presented in percentage of initial mass. Five samples are tested for each product.

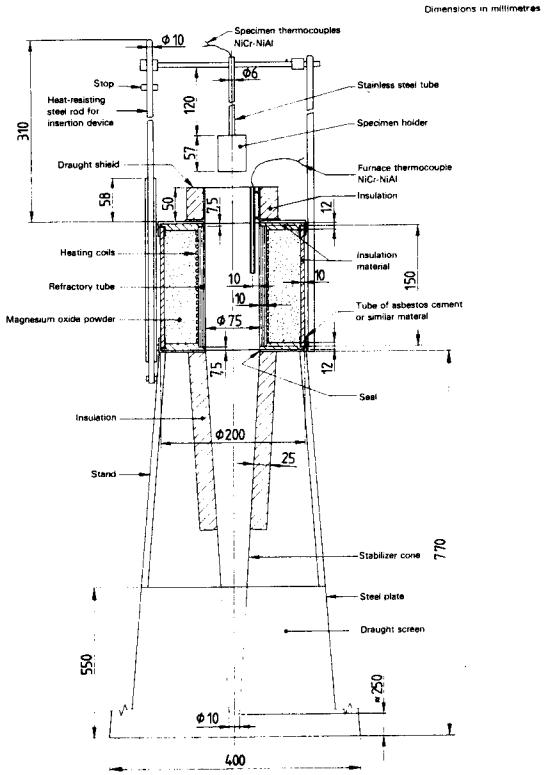

Fig. 1. Apparatus for testing non-combustibility according to EN ISO 1182

2.2 EN ISO 1716

The apparatus used for this method (Fig.2) is already widely known as an "oxygen bomb calorimeter". It consists mainly of:

- the high-pressure calorimeter vessel dipped in a water jacket equipped with the stirrer operated by a constant-speed motor;
- temperature measuring equipment that permits measurement of the temperature of the calorimeter vessel water with a precision of 0,002 °C;
- crucible made of heat-, corrosion- and oxidation resistant material able to keep the specimen in place;

- firing wire of platinum and ignition circuit.

Two samples are tested for each material.

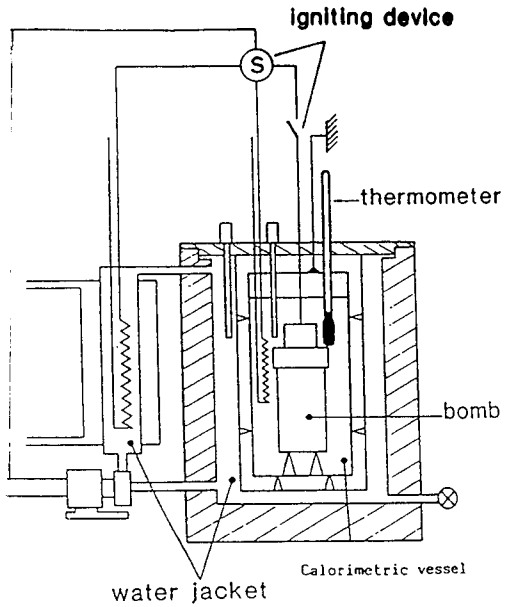

Fig.2 Scheme of the apparatus used for testing according to EN ISO 1716

3. CLASSIFICATION CRITERIA

Different classification criteria have been used for comparison: proposed in the new European classification system for building products (Table 1) and those used in Poland (Table 2) and Japan (Table 3). As one can see from the table 1, flooring materials has not been considered

although the same methods are used for testing of the high performance flooring materials (except for SBI).

Table 1. Criteria for non combustible products excluding floorings according to CEN [1]

Class	Test method(s)	Classification criteria	Additional classification
A1	EN ISO 1182 ([1]); *and*	$\Delta T \le 30°C$; *and* $\Delta m \le 50\%$; *and* $t_f = 0$ (i.e. no sustained flaming)	-
	EN ISO 1716	PCS ≤ 2.0 MJ.kg^{-1} ([1]); *and* PCS ≤ 2.0 MJ.kg^{-1} ([2]) ([2a]); *and* PCS ≤ 1.4 MJ.m^{-2} ([3]); *and* PCS ≤ 2.0 MJ.kg^{-1} ([4])	
A2	EN ISO 1182 ([1]); *or*	$\Delta T \le 50°C$; *and* $\Delta m \le 50\%$; *and* $t_f \le 20s$	
	EN ISO 1716; *and*	PCS ≤ 3.0 MJ.kg^{-1} ([1]); *and* PCS ≤ 4.0 MJ.m^{-2} ([2]); *and* PCS ≤ 4.0 MJ.m^{-2} ([3]); *and* PCS ≤ 3.0 MJ.kg^{-1} ([4])	
	EN xxxx (SBI)	FIGRA ≤ 120 W.s^{-1}; *and* LFS < edge of specimen; *and* $THR_{600s} \le 7.5$ MJ	Smoke production([5]); *and* Flaming droplets/ particles ([6])

([1]) For homogeneous products and substantial components of non-homogeneous products.

([2]) For any external non-substantial component of non-homogeneous products.

([2a]) Alternatively, any external non-substantial component having a PCS ≤ 2.0 MJ.m^{-2}, provided that the product satisfies the following criteria of EN xxxx(SBI) : FIGRA ≤ 20 W.s^{-1}; *and* LFS < edge of specimen; *and* $THR_{600s} \le 4.0$ MJ; *and* s1; *and* d0.

([3]) For any internal non-substantial component of non-homogeneous products.

(4) For the product as a whole.

(5) **s1** = SMOGRA ≤ 30m^2.s^{-2} *and* $TSP_{600s} \le 50m^2$; **s2** = SMOGRA ≤ 180m^2.s^{-2} *and* $TSP_{600s} \le 200m^2$; **s3** = not s1 or **s2**.

(6) **d0** = No flaming droplets/ particles in ENxxxx (SBI) within 600s; **d1** = No flaming droplets/ particles persisting longer than 10s in ENxxxx (SBI) within 600s; **d2** = not d0 or d1; Ignition of the paper in EN ISO 11925-2 results in a d2 classification.

Table 3. Criteria for non combustible products used in Poland.

Reference document	Criteria
PN-B-02862:1996	$\Delta T \le 50°C$; *and* $\Delta m \le 50\%$; *and* $t_f \le 20s$

Table 4. Criteria for non combustible products used in Japan.

Reference document	Draft criteria *)
JIS-A-1231	$\Delta T \le 20°C$; *and* $\Delta m \le 30\%$; *and* $t_f = 0s$

*) still under consideration, the table gives only one version of the proposed criteria.

4. EXPERIMENTAL RESULTS

The group of presumable non-combustible materials have been tested by means of earlier described test methods. Detailed results are presented in the Table 5. Only one of 6 materials studied has shown flaming during ISO 1182 test. But the time of flaming (92s) was much longer than acceptable limit 20s for Euroclass A2. For this materials also gross calorific value was over ten times higher than limit value 3MJ/kg.

Table 5. Experimental results.

	Material	EN ISO 1716 *) PCS MJ/kg	EN ISO 1182 *) ΔT °C	Δm %	t_f s
1	Gypsum-cellulose board ρ= 1000 kg/m^3	0,47	40,0	32,0	92
2	Silicate board #1 ρ= 450 kg/m^3	0,00	1,3	16,3	0
3	Silicate board #2 ρ= 870 kg/m^3	0,16	3,2	16,0	0
4	Mineral wool #1 ρ= 55 kg/m^3	0,03	28	2,0	0
5	Mineral wool #2 ρ= 45 kg/m^3	0,19	5,8	2,2	0
6	Mineral wool #3 ρ= 70 kg/m^3	0,23	5,4	3,2	0

*) given results apply only to the specific product tested

5. CONCLUDING REMARKS

The main test method, which constitutes the basis for European classification system is SBI. It has been developed by OLG (Official Laboratory Group) as new, original test method partly based on measuring technique and design of earlier known Room Corner test [3] prepared and standardised by ISO TC 92 SC1. Detailed description of SBI is beyond the scope of this paper, as it was not used in the course of experiments. Therefore only classification of non-combustible materials of Euroclass A1 and A2 is possible so far. Non combustible materials are expected not to contribute to the fire. The practical meaning of this requirement is, that a building material is considered non-combustible, if it neither ignites nor generates practically any smoke or combustible gases. For material # 1, the final classification was not possible, as it was condemned in both methods. For this material further tests according to at least SBI are necessary for final classification. From the summary of obtained classification (Table 6) one can see, that the new European system do not change classification for materials classified as non combustible or combustible according to the current Polish system. Although non combustible (according to EN ISO 1182) material #3 has not shown the best performance in EN ISO 1716 and was classified in CEN system as A2 .

In Japan the situation is more complex. Due to the significant delay in modification of the fire classification system the final criteria for non-combustibility of building materials are still not available. The presented here (see table 4) criteria are only one example of the considered classification criteria. The intensive work is still to be done and at the moment it is not possible to foresee, when the whole process will be finished.

Table 6. Comparison of possible classification.

	Material	Poland	Japan *)	CEN
1	Gypsum-cellulose board	combustible	combustible	B or lower
2	Silicate board #1	non combustible	non combustible	A1
3	Silicate board #2	non combustible	non combustible	A2
4	Mineral wool #1	non combustible	combustible	A1
5	Mineral wool #2	non combustible	non combustible	A1
6	Mineral wool #3	non combustible	non combustible	A1

*) still under consideration, the table gives only classification according to one version of the proposed criteria (see table 4)

The work will be continued. Listed materials are currently tested in the cone calorimeter but results are not yet available for publication. Also additional materials will be tested.

REFERENCES

[1] Draft prEN 13501-1 Fire classification of construction products and building elements-Part 1: Classification using data from reaction to fire tests; document CEN/TC 127 N 1493

[2] CEN TC 127 Business plan for the year 2000

[3] prEN ISO 1182 Reaction to fire of building materials- Non combustibility test

[4] prEN ISO 1716 Reaction to fire of building materials- Determination of gross calorific value

[5] ISO 9705 : 1993 Fire tests - Full-scale room test for surface products.

FIRE SAFETY OF STRUCTURES