FIRE PROPERTIES OF BUILDING CONSTRUCTION MATERIALS

The potential danger that a fire may present to the occupants of a building is dependent not only upon the resistance to fire of the various elements such as walls, floors, ceilings, etc. in the building, or the type and number of active fire-fighting or suppression systems incorporated in the building, but is to a large extent governed by the types of material in the building, **ie:** both the construction materials and the movable contents.

Whilst designers, fire departments and fire surveyors have little or no control over contents such as furnishings used in offices or residential buildings, they can control construction materials used internally for ceilings, partitions, decorative wall claddings, pipe and duct insulation, etc. and for this purpose they require a knowledge of the fire properties of such materials.

The following fire properties of a material will to a large extent determine the potential fire danger that the material can cause in a fire situation:

- Ease of ignition
- Flame spread
- Heat contribution
- Amount of smoke given off
- Toxicity of the smoke and combustion gases given off

The accompanying table is presented to assist persons in the choice of building materials. These symbols and remarks in the table are based on the experience of the NBRI during fire tests on the materials listed. The symbols allocated will give guidance to persons unfamiliar with the burning characteristics of a particular material.

Combustibility

Combustibility or non-combustibility was determined by using the test method in SABS Code of Practice: 0177; Part 5.

Ease of ignition

The ease of ignition rankings are based on the observations of the persons carrying out the tests as well as report in the literature.

1. Will not ignite, nor contribute heat to the fire
2. Will probably not ignite and burn but may contribute marginally to heat produced during a fire
3. Will be ignited by, say, a heat source equivalent to an upholstered chair
4. Will be ignited by a burning waste-paper basket half full of crumbled paper placed against it
5. Can be ignited by a small ignition source such as a match held to an edge.

Flame spread, heat contribution and smoke development

The rankings of flame spread, heat contribution and smoke development of the various materials are based on observations noted during various full-scale fire tests carried out at the NBRI and also, to a lesser extent, on the results obtained from small scale fire tests.

a)
b)
c)
d)
e)

Toxic

A
B
C
D

E

1	2	3	4	5	6	7	8	9
Material description	*Thickness (mm)*	*Combustibility*	*Ease of ignition*	*Flame spread*	*Heat contribution*	*Smoke development*	*Toxicity of combustion gases*	*Remarks*
Brickwork	any	NC	1	a	a	a	A	Good heat insulator; good resistance to fire.
Concrete	any	NC	1	a	a	a	A	Surface of very dense concrete can spall off in fir good resistance to fire.
Cement plaster	any	NC	1	a	a	a	A	Can spall off if not on mesh tied to wall or ceiling.
Mild steel	any	NC	1	a	a	a	A	Good thermal conductor. Yields at design workir stress at about 550 °C.
Aluminium	any	NC	1	a	a	a	A	Melting point is about 650 °C. Critical temperatu about 250 °C.
Flat asbestos cement sheet	any	NC	1	a	a	a	A	Dense grades, ie pressed sheets, are prone to expl sive delamination.
X-rated gypsum plasterboard	12	NC	1	a	a	b	B	Contains glass fibres in gypsum core. Has great flexural strength at high temperatures than plain G.I board. Good thermal insulator.
Plain gypsum plasterboard (GP)	12	NC	1	a	a	b	B	Less resistance to collapse than X-rated G.P. boar Good thermal insulation. Wet gypsum corrodes metal Smoke includes opaqueness from condensed steam.
PVC (vinyl) clad gypsum plasterboard	9 and 12	C	2 to 3	a to c	a	d	D	PVC cladding about 1,0 mm thick. Variation in PV formulations.
Vinyl (0,2 mm thick) clad gypsum plasterboard	12	C	1	a	a	c to d	C	Vinyl marginally increases the amount of smoke give off but the material remains relatively safe.
SA pine shelving	19	C	3 to 4	c	c	c	C	Thinner material would have a higher heat contributi index, ignite more easily, but have a lower smol development index.
Hardboard	6	C	4	c	c	b	C	Thinner material would have a lower heat contributi index and would ignite more easily. Low resistance fire penetration.
Softboard	12	C	5	d	c	c	C	Prone to smouldering for long periods and sudde flaming if exposed to a draught.
Wood veneer faced chipboard	19	C	3 to 4	c	c	b to c	C	Fair resistance to fire penetration. If used as wall cla ding adds high fire load.
Melamine faced chipboard	19	C	3	b	b	b	C	Melamine coating results in appreciable drop in flan spread index.
Cement bonded woodwool slabs	25	C	2	a	a	a	C	Does not burn freely. Very porous material which w allow the passage of hot gases. If clad on both side a safe material firewise.
Mineral fibre, acoustic ceiling tiles	16 to 19	C	2	a	a	a to c	C	Various types available. Considered a fire-safe ceili material. Good resistance to collapse during fire.
Vinyl-faced, glass-fibre ceiling tiles 1,0 kg/m²	25	C	2	a	a	c	C	Fire-safe ceiling material. Not much resistance collapse during fire. Vinyl facing very thin (0,1 mm).
Special paint-coated glass-fibre ceiling tile 3,6 kg/m²	25	C	2	a	a	a	C	Fire-safe ceiling material. Not much resistance collapse during fire.
Foamed phenolic board	25	C	2	a	a	a to c	C	At present probably the safest foamed plastic mater firewise. Not thermoplastic.
Foamed polycarbodiamide (PCD)	25	C	3	a	b	b	E	Not a freely available material at present. Not therm plastic. Behaviour will alter with chemical formulation.
Foamed polyisocyanurate board	25	C	2	a	b	a to c	D	Except for toxicity a fairly safe material firewise. N thermoplastic. Urethane content must be limited.
Foamed polyurethane board	25	C	5	b to d	b	d to e	E	Burns profusely. Properties depend on formulatic Not thermoplastic.
Foamed polystyrene board	25	C	5	c	c	e	C	Thermoplastic material; melts at between 93 a 143 °C. Sheds burning droplets of molten materi Does not stay in position.
Glass-fibre reinforced polyester (GRP) sheet	1 to 2	C	5	d	d	d to e	C	A single match will ignite the material, and it will co tinue to burn. Black smoke is given off.
Glass-fibre reinforced polyester sheet, fire retarded	1 to 2	C	3	b	b	e	D to E	Will burn and give off much black smoke in a fully d veloped fire.
Acrylic sheet backed by GRP sheet	4	C	5	d	d	d	C to D	Easily ignited and burns vigorously.
Polycarbonate	9	C	1	a	a	a	B	Thermoplastic material: softens at about 210 °C a flows at 400 °C. Has low resistance to fire penetration

ed inhalation

References:
The fire properties of some common building construction materials
by V R Boardman and E G Williams, National Building Research Institute, CSIR

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