Image Cover Sheet

CLASSIFICATION	SYSTEM NUMBER 511907
UNCLASSIFIED	

TITLE

Inorganic Intumescent Filler for Polymer Composites

System Number:

Patron Number:

Requester:

Notes: Paper #33 contained in Parent sysnum #511874

DSIS Use only:

Deliver to: CL

#511907

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Inorganic Intumescent Filler for Polymer Composites

by J.O. Bernt

J.O. Bernt and Associates Limited
3375 Laird Drive, Unit 3, Mississauga, Ontario L5L 5R7

ABSTRACT

This discussion is about the use of an inorganic intumescent filler compounded with LDPE (low density polyethylene) and used as the core material for metal composites.

The filler is a further development of the inorganic intumescent coating material developed with DREA and NDHQ support.

The metal composite was developed to meet and exceed the specifications for currently available, non-combustible siding material for commercial/industrial buildings.

Due to the high strength, low weight of this composite we believe it could find use in naval ships for interior partitions, non-structural bulkheads and/or various furnishings, etc. where it would offer significant weight savings.

The paper will further discuss a unique technique for forming glass microballoons in-situ in the composite core material, thus achieving light weight while retaining adequate compressive strength.

INTRODUCTION

This discussion is about the use of an inorganic intumescent filler compounded with LDPE (low density polyethylene) and used as the core material for metal composites.

The filler is a further development of the inorganic intumescent coating material developed with DREA and NDHQ support.

The metal composite was developed to meet and exceed the specifications for currently available, non-combustible siding for commercial/industrial buildings.

Because the composite has high strength, low weight, very low flammability and smoke generation, we believe it could find use in naval ships for interior partitions, non structural bulkheads and/or various furnishings.

We have a few samples of the composites, two made with aluminum and two made with galvanized steel, as well as samples of the core material – both expanded and un-expanded. We will pass the samples around for you to look at.

We have prepared a table (Slide 1) to show you the major characteristics of known commercially available composites.

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The first three numbers – flame spread, smoke development and BTU/ft are important from a fire and flammability point of view.

The last number – peel strength, is important for the strength of the composite.

Based on this comparison we have succeeded in developing a material which is about equal in flame spread, but considerably better in respect to smoke development, BTU content and peel strength.

As you saw in the preceding table the composites made by Reynolds and Alucobond both have 5-6000 BTU/ft2 which corresponds to a particulate loading of about 75% by weight.

We knew it was not possible to increase the loading without losing coherence of the compound.

We had observed, that in low level cone-calorimeter test, the samples had expanded, but the LDPE was not completely destroyed. Microscopic examination revealed that the LDPE matrix was full of glass microballoons formed by the expanding silicates.

We then developed a silicate mix which could be compounded at 155 deg.C without expanding, but would have completely expanded at 300 deg.C. The silicate microballoons formed from this mix are nearly insoluble in water.

Slide II

This microphotograph shows the surface of the core material after we have peeled off the metal

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laminate. If you look closely, you see small bright spots covering the picture.

These spots are light focused by the surfaces of the microballoons, probably by the inside surfaces of broken microballoons.

Because the microballoons are completely surrounded by the LDPE matrix they are very strong in compression. When expanded to twice the original volume the compound has a compressive strength of at least 800 lbs./I2 or about 57 tons/ft.2.

The expansion process, due to the high temperatures involved, must take place in the absence of oxygen to avoid burning the LDPE. Our test shows that LDPE does not degrade due to high temperatures provided oxygen is not present.

We also tested PVC in this process. PVC, however, starts losing chlorine at 200-250 deg.C which destroys the material completely.

Slide III

These curves are TGA and DSC plots from 0-600 deg.C of the intumescent powder. The plots illustrate one of the ways in which we can control the temperature at which intumescence begins. The higher the drying temperature the higher the intumescent temperature.

In conclusion I like to think that we have developed a material which could be useful to the Navy.

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We have already received strong expressions of interest from Reynolds Metal Company and from a large Canadian construction materials group.

We will also investigate the use of the core material as acoustic and thermal insulation.

Preliminary testing indicates that it may be possible to expand the core material up to at least 1 ½" thick using high intensity microwaves.

Slide 1

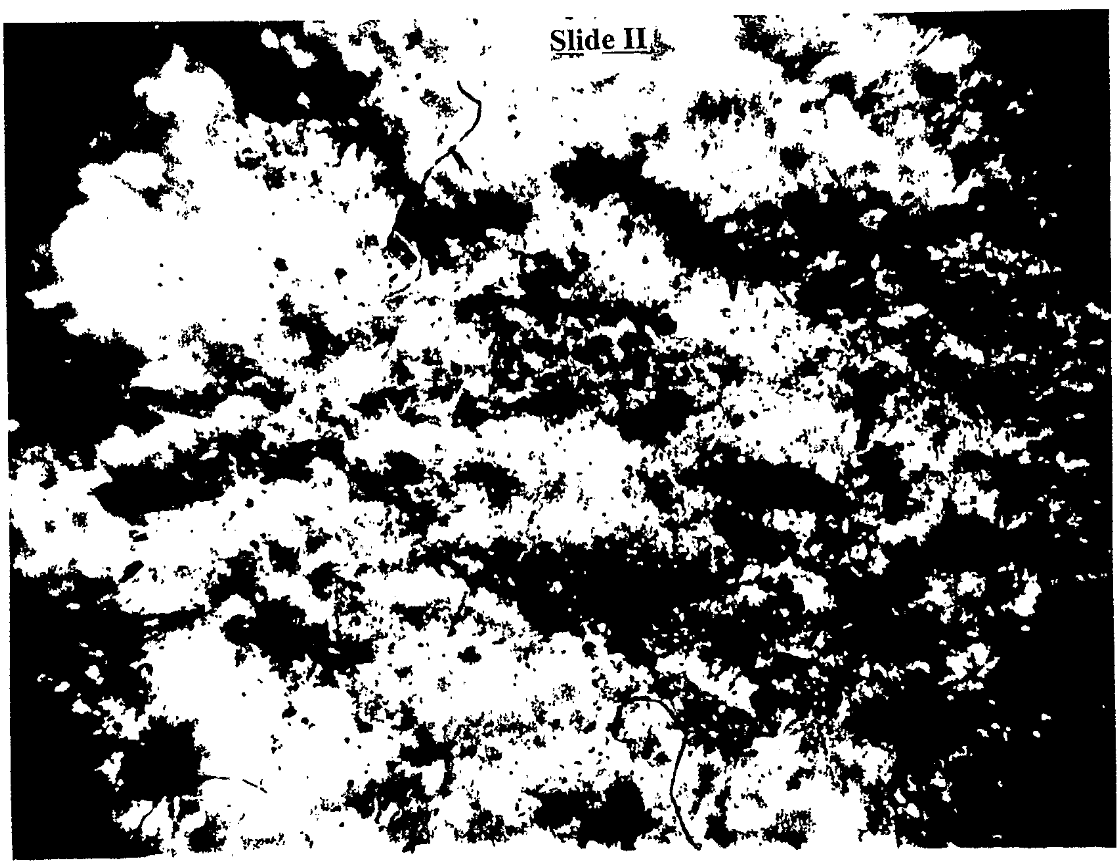
PYROPHOBIC SYSTEMS LTD.

3375 Laird Rd., unit 3, Mississauga, Ontario L5L 5R7
Tel: (905) 569-7392 Fax: (905) 569-7696 Email: jammbco@aol.com

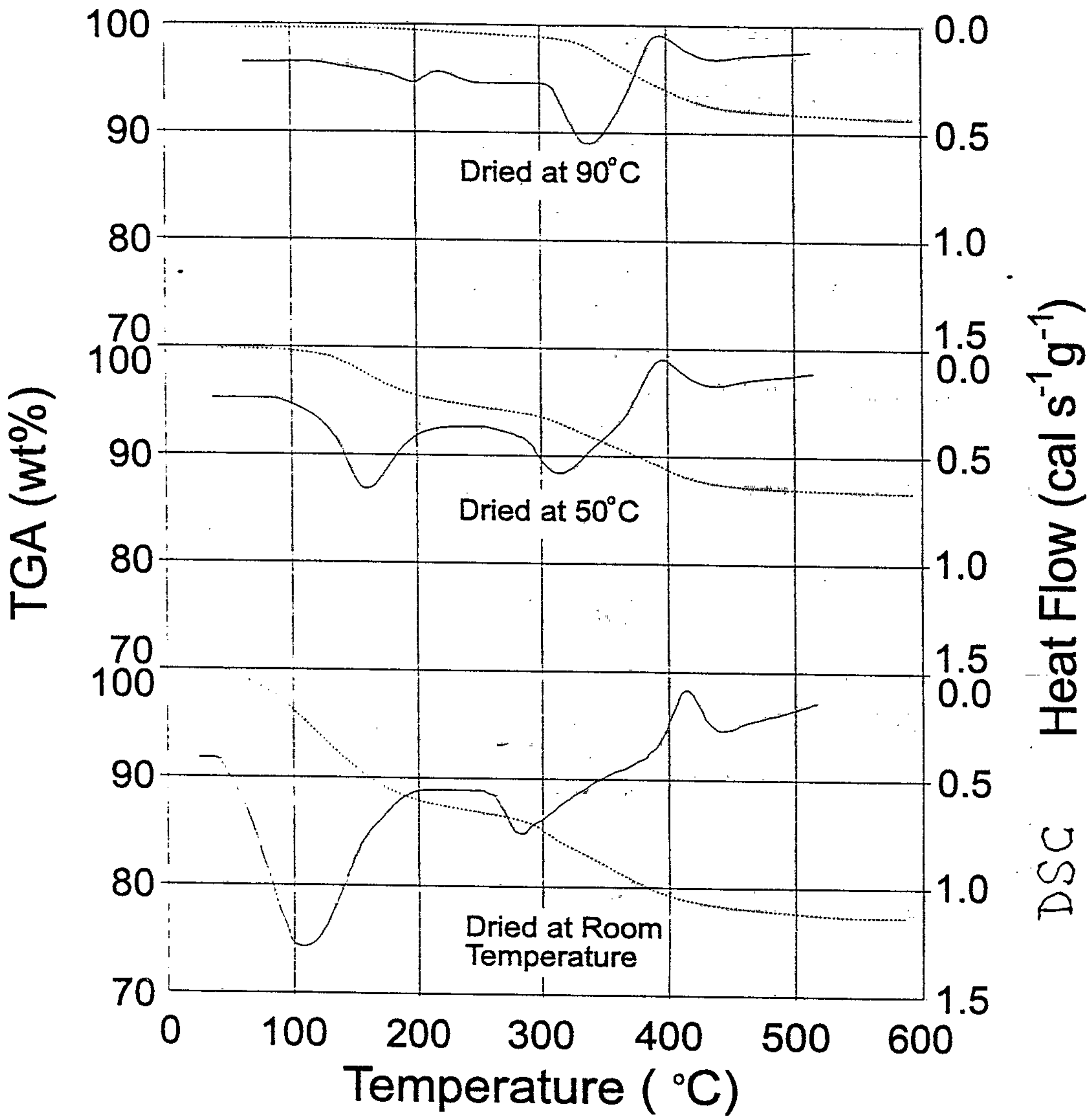
Major Characteristics of Metal Composite Panels

Manufacturer	Flame Spread (E84)	Smoke Develop (E84)	BTU Per FT^2	Peel Strength Lbs/Inch
Pyrophobic	**12**	**15**	**2500**	**40**
Reynolds	15	30	5000	20
Alucobond	10	105	6000	26

Slide II



Slide III



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0.5
1.0
1.5
0.0
0.5
1.0
1.5
Dried at 90°C
Dried at 50°C
Dried at Room Temperature
TGA (wt%)
Heat Flow (cal s-1g-1)
DSC
0
100
200
300
400
500
600
Temperature (°C)