800-631-8001 www.agreenroof.com

LIVING WALL Burn Test – Recycled Plastic / Felt Sheet, Polypropylene, and Aluminum Living Walls………Which one will prevail?

This paper draws on the concerns raised in Hamish Champ's article, *"Combustibles ban could hit green walls, warns designer"* (December 3, 2019). In the article, Buck expressed concerns about the potential banning of materials used in green façades, noting that "they are, in effect, combustible products."

With over two decades of experience in living wall manufacturing, **Green Living Tech (GLT)** has developed a comprehensive understanding of the most commonly used materials in commercial living wall systems. These products can largely be grouped into two categories:

1. **Plastic-based systems**, most commonly made from **Polypropylene (PP)**. These plastics are often blended with natural or synthetic fibers—such as wool, rayon, or petroleum-based acrylics—to create flexible sheet materials.
2. They are also formed or molded into more ridged structures.
3. **GLT Panel systems** are constructed using aluminum.

This paper evaluates the fire performance of materials used in hydroponic sheet systems, felt-like layered systems, systems wrapped in synthetic felt bags, plastic tray/shelving units, and aluminum panels.

Based on comparative testing and video evidence, once ignition occurs, the results are clear: ***None of the tested systems matched the fire performance of GLT's Class A-rated products***.

Alarmingly, **among all reviewed product specifications, only Green Living Tech discloses a fire rating**—specifically, a **Class A Fire Rating**, the highest internationally accepted rating.

Polypropylene (PP), it remains the most widely used material across the industry. PP is a linear hydrocarbon polymer (CnH2n) with a melt point of approximately **130°C (266°F)**. When exposed to heat, it becomes a flammable liquid. At temperatures above **100°C**, PP begins to dissolve in aromatic hydrocarbons like **benzene** and **toluene**—with benzene being both widely used and **highly carcinogenic**. For context, the average high-rise fire reaches temperatures around **593°C (1100°F)**, far exceeding PP's melting point.

In conclusion, the widespread use of flammable materials—particularly polypropylene—presents a clear fire hazard in living wall systems.

Polypropylene (PP) (Cont.)

UL 94 Flammability Standard and Product Failure Analysis

UL 94 is a plastics flammability standard developed by **Underwriters Laboratories (USA)**. It classifies plastic materials based on how they burn in various orientations and thicknesses. The standard includes six classifications, ranging from the least flame-retardant to the most, and is widely used to assess fire safety in plastic components.

In the internal testing—documented in the accompanying video—the **Polypropylene-based product** exhibited **complete failure** against the UL 94 burn classification criteria. Not a single requirement was met across the rubric.

Once ignited, the material required the use of a **foam fire extinguisher** for suppression. Attempts to manually fan the flames only accelerated combustion. As the material melted, it dripped **aromatic hydrocarbons**, which continued to burn on contact and significantly increased the potential for fire spread and intensity.

The video also shows the product tested in both **horizontal and vertical orientations**, consistent with its real-world mounting applications. This ensures the evaluation reflects realistic installation conditions, not isolated laboratory scenarios. At every level of the UL 94 rubric, the **Polypropylene material failed, confirming its high flammability risk in applied settings.**

UL 94 RATING	DEFINITION OF RATING	
HB	Slow burning on a horizontal part	FAIL
V-2	Burning stops within 30 seconds on a part allowing for drops of vertical flammable plastic.	FAIL
V-1	Burning stops within 30 seconds on a vertical part allowing for drops of plastic that are not inflames.	FAIL
V-0	Burning stops within 10 seconds on a vertical part allowing for drops of plastic that are not inflames.	FAIL
5VB	Burning stops within 60 seconds on a vertical part allowing for drops of plastic that are not inflames.	FAIL
5VA	Burning stops within 60 seconds on a vertical part allowing for drops of plastic that are not inflames.	FAIL

Fire Performance of Aluminum Components in GLT Living Wall Systems

Unlike many polymer-based materials, **aluminum and aluminum alloys do not burn or contribute to combustion**. As demonstrated in the video, the aluminum **Plug and Play** living wall panel remained unaffected—showing no signs of warping, melting, or ignition.

Even under extreme incendiary conditions, **aluminum does not ignite** and will **not sustain combustion**, making it one of the safest materials for fire-sensitive applications. According to The Aluminum Association, aluminum is also non-sparking in all environments and when in contact with any material.

When tested against **ASTM** and **British fire safety standards**, aluminum consistently achieves **the highest flame spread resistance ratings**. This is due to its inherent properties: it is non-ignitable under normal atmospheric conditions and does not support flame propagation.

As such, aluminum remains a superior material choice for the GLT living wall components where **fire performance and occupant safety are critical considerations**.

The GLT Living Wall ASTEM E84 Results:

Flame spread = 0
Smoke Development = 0

	Insertion Time (s)	Ignition Time (min:s)	Flameout (min:s)	Duration of flaming (min:s)	Criteria: No flaming after first 30 s	Observed Smoke (min:s)	Observed Soot (min:s)	Total Test Time (s)
1	20	N/A	N/A	0:00	Pass	None	None	2686
2	26	N/A	N/A	0:00	Pass	None	None	3462
3	48	N/A	N/A	0:00	Pass	None	None	3606
4	48	N/A	N/A	0:00	Pass	None	None	3190

https://www.aluminum.org/health-safety

Aluminum's Fire Behavior and Intrinsic Safety Characteristics

A material's performance in a fire scenario is governed by its **intrinsic physical properties**—such as melting point, specific heat capacity, and thermal conductivity—as well as its **flammability, smoke emission, and structural stability under heat**. In the case of aluminum, it is now a widely recognized and well-documented fact that **aluminum does not burn**, **does not emit smoke when exposed to flame**, and **does not produce sparks upon impact**.

These properties make aluminum an ideal material for fire-sensitive applications. As demonstrated in testing, the **aluminum Plug and Play system** is clearly the **safest among all materials evaluated**.

Scientific studies have shown that aluminum only becomes ignitable in highly unusual conditions—specifically in **pure oxygen at extreme pressures (1013 bar)**, where its ignition temperature exceeds **1000°C (1832°F)**. Even under these conditions, aluminum's natural defense mechanism comes into play: a **stable oxide layer** forms on the surface of the metal, effectively sealing it off from oxygen and **preventing sustained combustion**.

In essence, aluminum's behavior under heat is defined by **two competing reactions**:

1. **Oxidation**, which forms a protective, non-flammable oxide barrier.
2. **Combustion**, which is prevented by that very barrier.

This self-limiting characteristic is what makes aluminum particularly resistant to ignition and **exceptionally safe in real-world fire scenarios**, especially when compared to combustible or smoke-producing materials commonly used in building systems.

Aluminum's Reflective Properties and Fire Barrier Potential

Aluminum possesses **exceptionally high reflectivity**, capable of reflecting **80–90% of incident radiant energy**. This high reflectance plays a critical role in fire scenarios: aluminum structures exposed to radiant heat from a fire **take significantly longer to heat up**, thereby **delaying the spread of fire** through conductive heat transfer.

Even when subjected to elevated temperatures, aluminum retains much of its reflective capacity. At surface temperatures between **500°C and 600°C**, aluminum still reflects approximately **70%** of radiant heat. This stability in thermal reflectivity makes aluminum an inherently **passive fire mitigation material**.

In the context of the **GLT Plug and Play Living Wall**, this property suggests that the aluminum panels could theoretically function as an **extended fire barrier**. While **GLT has not officially tested or marketed these systems as rated fire barriers**, the physical properties of aluminum strongly support the possibility. From a theoretical standpoint, these systems may contribute not only to **slowing heat transmission** between compartments or rooms but also to **containing fire** by resisting ignition and reducing thermal conduction.

When considered alongside GLT's Class A fire rating and aluminum's known fire-resistant behavior, the system's structure **could be viewed as a dual-layered protection mechanism**—providing both **time-based resistance** and **heat deflection**. Within the context of this paper, it is reasonable to consider the GLT Living Wall as a potential contributor to **passive fire protection** in architectural applications.

As industry attention grows around fire safety, **GLT stands out as the only manufacturer prioritizing and publishing fire-safe specifications**, offering systems that are not only sustainable but also meet critical safety standard

References

Fire, ALFED Notice, 1999 - Aluminum Federation Limited, Broadway House, Calthorpe Road, Five Ways, Birmingham B15 1TN, UK.

Fire Resistance and Flame Spread Performance of Aluminum and Aluminum Alloys, The Aluminum Association, First Edition, December 1997.

Resistance l'incendie des constructions en aluminum, V. J. HILL, Rapport commit! International de development de aluminum. CIDA Report 7132, 1971.

Combustion of metals in oxygen, A. V. GROSSE, J. B. CONWAY, Industrial and Engineering Chemistry, Vol. 50, 1958, pp. 663-672.

Temperature of aluminum during combustion in oxygen / argon media in nitrogen and in air, R. BOURRIANES, Proceedings of the Académie des Sciences, Paris, Vol. 275, 1972, pp. 717-720.

BS 476, Classification of Materials for Fire Resistance.

ASTM, Designation E136: Standard Test Method for behavior of materials in a vertical tube furnace at 750 C.

European Directives 97/69, 80/1107, 89/391, 98/24.

Material Aspects of Fire Design, STEINAR LUNDBERG, Hydro Aluminum Structures, Karmoy, TALAT Lecture F2502 Eurocode 9: Design of Aluminum

Structures Part 1-2 General: Structural fire design, CEN TC 250, ENV 1999-1 2:2000.

Fire Stability Metallic Protective Material, C. AIMONE CAT, J. KRUPPA, G. LAMBOLEY, CTCIM BP1, F78470

"Standard Test Methods for Fire Tests of Building Construction and Materials," ASTM E119, Part 04.07,

Classification of Materials for Fire Resistance, Part 5: Ignitability of Building Materials" (now replaced by Part 4), British Standard 476, The British Standards Institution

https://www.creativemechanisms.com/blog/all-about-polypropylene-pp-plastic

https://www.sciencedirect.com/science/article/pii/S1110062115300921

https://www.professionalplastics.com/UL94FlameClassificationsForPlastics