

# Introduction to a new type of Flame Retardant

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**Flame Retardant hydrotalcite**

**HT-88F**



# Role of Flame Retardants



## PVC Flame Resistance

PVC is inherently resistant to fire due to its chlorine content. However, when plasticizers are added (as in soft PVC), it becomes more flammable.

## Function of Flame Retardant.

Flame retardants inhibit combustion reactions and help reduce heat generation and smoke emission during burning

## Common Flame Retardants.

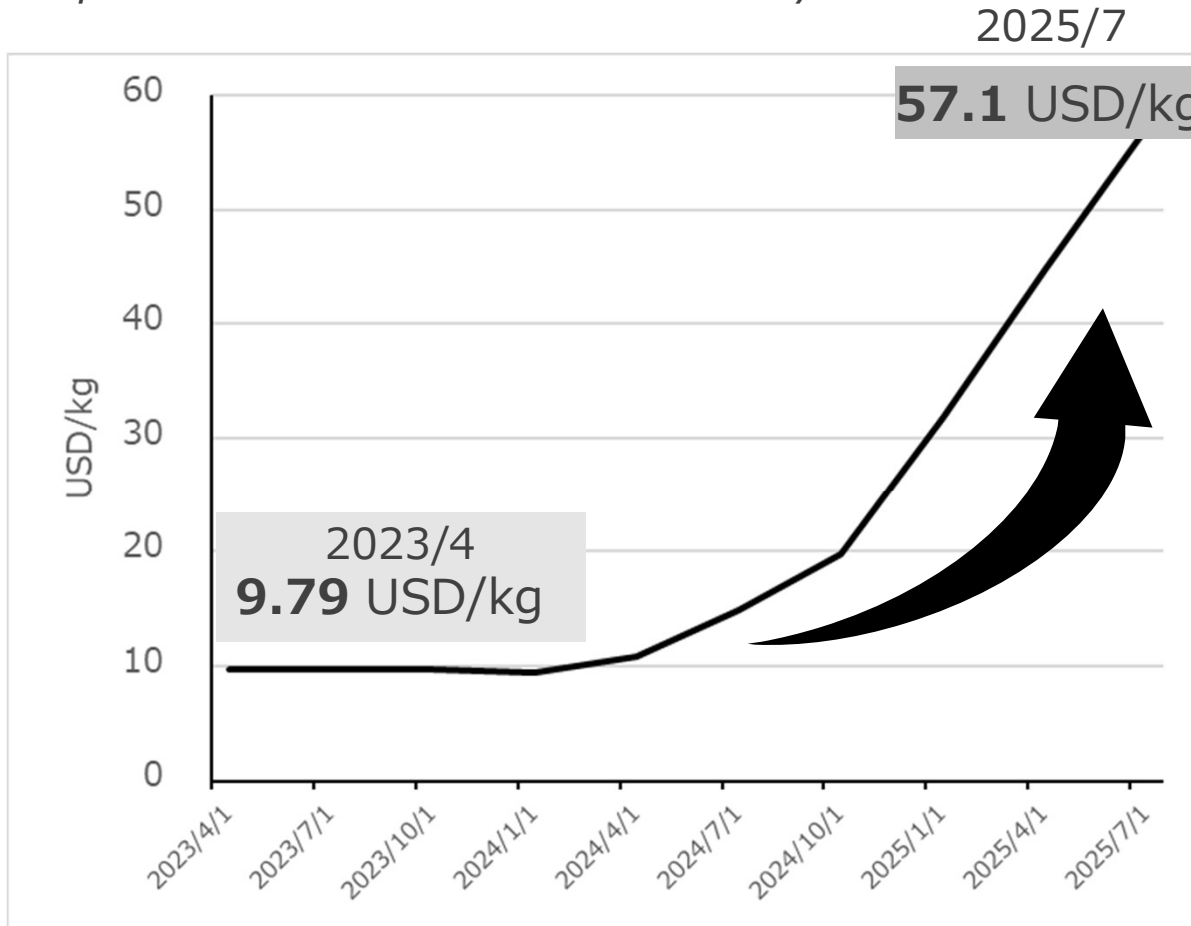
Antimony trioxide ( $\text{Sb}_2\text{O}_3$ ) is the most widely used flame retardant.

## Applications and Regulations.

Flame retardants are legally required in applications such as wires, cables, building materials, and automotive components to ensure safety.

# Regulations on Antimony Trioxide and Alternative Flame Retardants

Japan Customs Statistics of Antimony



※1USD=153円(2025.10.8)

**Market Outlook** -The demand for new flame retardant materials—serving as alternatives to antimony trioxide—is expected to increase.

## Export regulations

China imposed export restrictions starting from September 2024.

## Environmental issues

Antimony trioxide is classified as a *Category 2 Specified Controlled Substance* and a *Specially Controlled Substance in Japan*.

# New Flame Retardant



## Commitment to Sustainability

To help realize a sustainable society,

*Sakai Chemical has developed Flame Retardant HT-88F and a New Flame Retardant.*

## Challenges in Flame Retardancy

PVC flame retardancy faces challenges in enhancing fire safety and complying with environmental regulations.

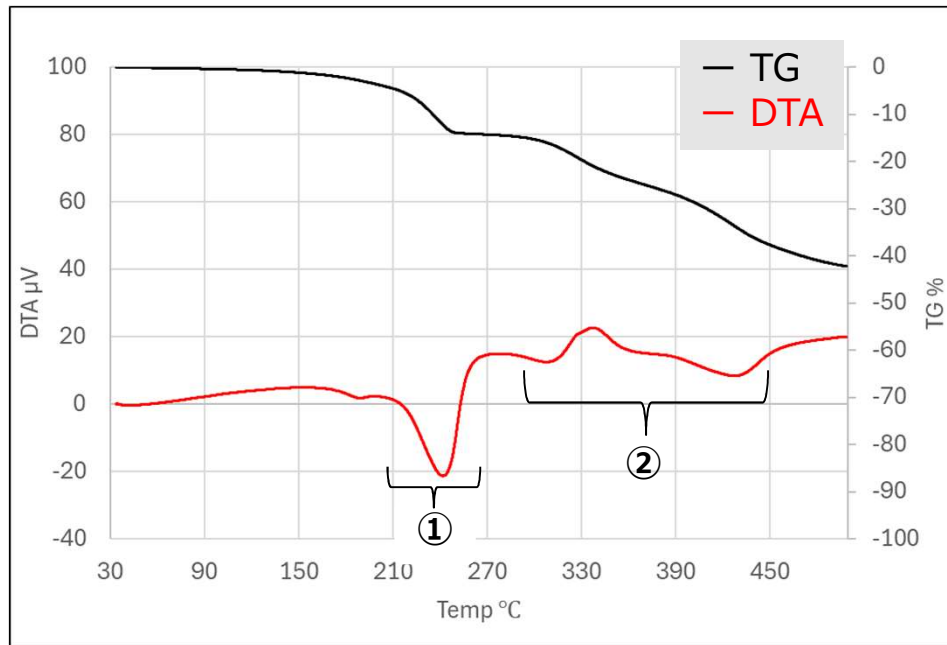
## Shift to Alternative flame retardant

There is a growing transition from antimony- and halogen-based retardants to non-halogen, non-antimony alternatives for improved health and environmental safety.

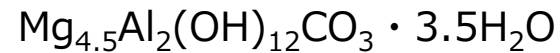


# Flame Retardant Hydrotalcite HT-88F

TG-DTA



## Chemical formula



## Endothermic effect

- ① Dehydration of crystal water during HT
- ② Dehydration of metal hydroxides during HT

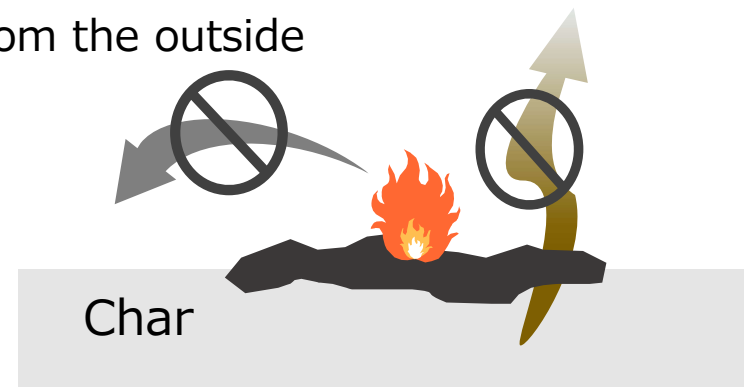
## Oxygen dilution effect

- Separation of carbon dioxide from HT

## Char formation

Prevention of heat transfer from the outside

- $\text{Mg}(\text{OH})_2 \rightarrow \text{MgO} + \text{H}_2\text{O}$
- $2\text{Al}(\text{OH})_3 \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2\text{O}$



# Flame Retardancy Evaluation Methods

- **UL-94**

A safety standard used to determine the flammability of plastic materials.

*Non-flammability ranking: **V-0 > V-1 > V-2** → **Flammable***

- **L.O.I (Limiting Oxygen Index)**

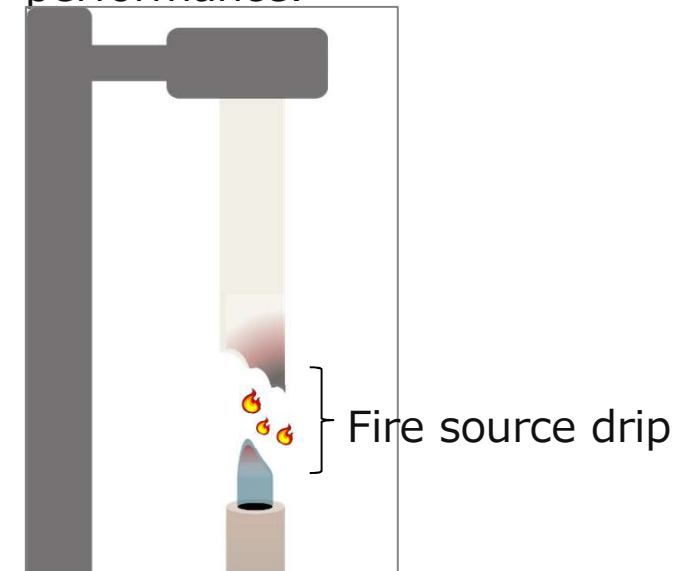
Measures the minimum oxygen concentration required for a material to sustain combustion.

*Higher L.O.I value → Greater non-flammability*

# Test result of HT-88F UL-94 & L.O.I

<Test Formulation>	①	②	③
PVC (P=1000)	100	100	100
Plasticizer	50	50	50
Ca/Zn Stabilizer	5	5	5
Sb <sub>2</sub> O <sub>3</sub>	5	2	2
HT-88F	-	3	20
Number of drips/5 pieces	0	4	4
UL-94	V-0	V-0~ <b>V-2</b>	V-0~ <b>V-2</b>
L.O.I. Limiting Oxygen index	30.5	28.0	29.5

- HT-88F can reduce the use of antimony trioxide while maintaining Flame Retardant performance.



## Technical issues

- When HT-88F is added as a flame retardant, the test piece tends to drip during combustion.
- Flame retardant performance may fluctuate due to dripping. → Depending on testing variation, the result may range between V-0 and V-2.

# **New Development: Composite-Type Flame Retardant Material**



# 1. New Flame Retardant – Composite Type

Types of Resin	Grade Name	Features
PVC	AA-1000Series	<ul style="list-style-type: none"><li>• Enables reduction of antimony content in the compound.</li><li>• Improved anti-dripping performance.</li></ul>
	AA-3000Series	<ul style="list-style-type: none"><li>• No antimony trioxide required.</li><li>※ Under development</li></ul>
PE	AA-5000Series	<ul style="list-style-type: none"><li>• No antimony trioxide required.</li><li>※ Under development</li></ul>

## 2. Flame Retardancy Evaluation (for PVC)

	①	②	③	④	⑤	⑥
Sb <sub>2</sub> O <sub>3</sub>	5.0	2.0	2.0	-	-	-
<b>AA-1000</b>	-	-	3.0	20.0	-	-
AA-3000	-	-	-	-	5	20.0
Number of drips/5 pieces	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
UL 94	V-0	V-1	<b>V-0</b>	V-0	V-0	<b>V-0</b>
JIS K 7201-2	30.5	28.0	<b>28.0</b>	27.5	26.0	<b>29.5</b>

### Formulation

PVC (P=1000) 100PHR  
 Plasticizer 50PHR  
 Ca/Zn Stabilizer 5PHR  
**Flame Retardant @**

JIS K 7201-2 :In Japan, there are national standards called JIS (Japanese Industrial Standards).

UL94 : Standardized by Underwriters Laboratories, Inc.

## AA-1000 vs. Al(OH)<sub>3</sub>, Mg(OH)<sub>2</sub>

<Formulation>	①	②	③	④	⑤
PVC (P=1000)	100	100	100	100	100
Plasticizer	50	50	50	50	50
Ca/Zn Stabilizer	5	5	5	5	5
Sb <sub>2</sub> O <sub>3</sub>	5	2	2	2	2
<b>AA-1000</b>			3		
<b>Mg(OH)<sub>2</sub></b>				3	
<b>Al(OH)<sub>3</sub></b>					3
Number of drips /5 pieces	0	0	0	3	3
UL-94V	V-0	V-1	<b>V-0</b>	<b>V-2</b>	<b>V-2</b>
L.O.I. (Limiting Oxygen Index)	30.5	28.0	28.0	27.5	27.5

# AA-3000 vs. $\text{Al}(\text{OH})_3$ 、 $\text{Mg}(\text{OH})_2$

< Formulation >	①	②	④	⑥	⑧	⑨	⑪
PVC (P=1000)	100	100	100	100	100	100	100
Plasticizer	50	50	50	50	50	50	50
Ca/Zn Stabilizer	5	5	5	5	5	5	5
$\text{Sb}_2\text{O}_3$	5						
AA-3000		5	20				
$\text{Mg}(\text{OH})_2$				5	20		
$\text{Al}(\text{OH})_3$						5	20
Number of drips /5 pieces	0	0	0	4	2	2	2
UL-94V	V-0	V-0	V-0	V-2	V-2	V-2	V-2
L.O.I. (Limiting Oxygen Index)	30.5	26.0	29.5	24.0	24.0	25.0	25.0

### 3. Flame Retardancy Evaluation (for PE)

	①	②	③
Sb <sub>2</sub> O <sub>3</sub>	15.0	-	-
Brominated flame retardants	45.0	-	-
<b>AA-5000</b>	-	<b>60.0</b>	<b>100.0</b>
UL-94	V-0	V-1	V-0

#### Formulation

PE	100PHR
CPE	50PHR
Stearic acid	5PHR
<b>Flame Retardant</b>	<b>@</b>

#### Notes:

- *JIS K 7201-2*: In Japan, flammability is evaluated according to national standards known as **JIS (Japanese Industrial Standards)**.
- *UL-94*: Standardized by **Underwriters Laboratories, Inc.**

# Flame Retardancy Test Results

## Combustion state

### UL-94 combustion condition

Antimony trioxide  
+ brominated  
flame retardant



Composite Flame  
Retardant  
Developed grade



### Composite Flame Retardant — Features of the Developed Grade

- When **antimony trioxide** and brominated flame retardants are used, **black smoke** is generated during combustion.
- The **composite flame retardant** contains **no antimony trioxide** or brominated flame retardants, **reducing smoke generation** and ensuring environmentally friendly combustion.

# Summary

## HT-88F (Flame Retardant Hydrotalcite)

- Can reduce the required dosage of antimony trioxide.

## AA-1000 (Antimony Trioxide Combined Grade for PVC)

- Prevents dripping during burning and provides a stable Flame Retardant effect (V-0 rating).

## AA-3000 (Antimony-Free Grade for PVC)

- Suppresses dripping during combustion and provides a stable Flame Retardant effect comparable to 5 PHR of antimony.
- Achieved equivalent performance at around 20 PHR (L.O.I. = 29.5).

## AA-5000 (PE Resin Grade)

- Achieves a V-0 rating in 100 PHR PE formulation, equivalent to the effect of 15 PHR antimony trioxide + 45 PHR brominated flame retardant.



# Thank you

