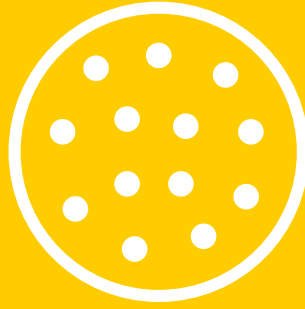


## TECHNICAL STUDY



**Flame  
retardant**



**Improved  
dispersion**



**Reduced  
costs**



**Enhanced flow  
improvement**



**ACHIEVEMENT OF THE UL 94 V0 STANDARD WITH  
REDUCED AMOUNTS OF FLAME RETARDANT**

Halogen-free flame-retardant polyamide  
formulations with CEVO® 3105

## Introduction

PA 6 and PA 66 have good mechanical properties, high abrasion resistance, and good chemical resistance. They are suitable for applications such as gears, bearings, bushings, cable ties, connectors, housings, and automotive parts.

PA66 has an inherent UL 94 rating of at best V2. This means that the afterburning time of a test specimen must not exceed 30 seconds after removal of the ignition source. Any material dripping off during the test may ignite the cotton placed under the test specimens. Polyamide is therefore defined self-extinguishing.

The more demanding UL 94 V0 flammability standard for plastic materials is used in many different devices and appliances. It is important for applications that require high fire safety, such as electronics, aerospace, automotive, and medical devices. The test is considered to have been passed if the material stops burning within 10 seconds on

a vertically positioned test specimen after removal of the ignition source and dripping particles do not ignite the cotton placed under the test specimen. To achieve the V0 classification according to UL 94, flame retardants must be used.

An even distribution of the respective flame retardant is essential to achieve the optimal flame retardancy classification and can also have an influence on the mechanical properties. Optimal distribution can be achieved by selecting suitable incorporation conditions (screw geometries) and/or by using suitable dispersing lubricant formulations. In the present study, the effect of CEVO® 3105 on the fire retardance efficiency of different concentrations of melamine cyanurate has been tested in different PA formulations. Calcium stearate served as a comparison additive.

## Results

### Test conditions and material

To achieve the V0 classification according to UL94 with standard lubricants like calcium stearate, dosage rates for melamin cyanurate of 12.5% for PA6 and 10% for PA66 are necessary. In the present study using lower flame retardant concentrations and calcium stearate, the test was not passed and a downgrade to V2 took place (Table 1, marked orange).

By replacing calcium stearate with CEVO® 3105 as a lubricant and dispersant, the use of flame retardants can be significantly reduced: to 10% for PA6 and to 8% for PA66 (Table 1, marked green).

In both PA types, 20% of the flame retardant used could be saved - the V0 test was still successfully passed. In analogy, comparable results were achieved with other halogen-free flame retardants like phosphorus-based flame retardants in combination with CEVO® 3105.

#### Test material

Melamin cyanurate: NORD-MIN MC 25 (Nordmann, Rassmann GmbH)
Calcium stearate S: Faci S.p.A.
PA6: Domamid 27 (Domo Chemicals)
PA66: Zytel 101 NC010 (Celanese Corp.)

#### Test equipment

Twin screw extruder ZSK 25 (Berstorff)
Temperature profile: PA6: 255/260/265/265/260/260/260/260 °C PA66: 275/270/270/265/265/265/265/265 °C
Throughput: 25 kg/h
Screw Rotation Speed: 200 rpm

	Compound formulation						Flammability test
	PA6 L <sub>v</sub> = 2,71 [%]	PA66 L <sub>v</sub> = 2,64 [%]	Melamin- cyanurate <sup>1</sup> [%]	CEVO® 3105 [%]	Calcium- stearate [%]	Stabiliser <sup>1</sup> [%]	
PA6 1	86,6	-	12,5	-	0,4	0,5	V0
PA6 2	86,6	-	12,5	0,4	-	0,5	V0
PA6 3	89,1	-	10,0	-	0,4	0,5	V2
PA6 4	89,1	-	10,0	0,4	-	0,5	V0
PA66 1	9,0	80,1	10,0	-	0,4	0,5	V0
PA66 2	9,0	80,1	10,0	0,4	-	0,5	V0
PA66 3	9,0	82,1	8,0	-	0,4	0,5	V2
PA66 4	9,0	82,1	8,0	0,4	-	0,5	V0

Table 1 Reaching V0: With CEVO® 3105, the use of flame retardants can be significantly reduced.

## Conclusion

Using compounds based on PA6 and PA66, it has been shown that the use of **CEVO® 3105 enables the formulation to achieve the classification V0 according to UL94 while at the same time reducing the amount of flame retardant.** Calcium stearate served as a standard lubricant for comparison.

CEVO® 3105 helps to distribute the flame retardant very evenly in the polyamide matrix and does not have a negative effect on the dripping behavior of the respective test rod (no ignition of the cotton backing due to dripping melt). For information on the positive effects of CEVO 3105 on shear rate and flow behavior, see Technical Study: The effect of VOELPKER Additives on the flow properties and torque of PA 6



<sup>1</sup> Proprietary formulation, contact us for more information.

<sup>2</sup> <https://www.shopulstandards.com/ProductDetail.aspx?productId=UL94>

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