

# Three fire retardant soft PVC with excellent environmental performance, ready for industrial use

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# Background and purpose

- ✓ The overall objective with the formulations presented in this document is to improve the environmental performance of the PVC application with the same or better fire and smoke performance
- ✓ The products physical and processing properties are the same or similar to initial recipe
- ✓ A summary of our results are presented in the form of three formulations for three products
- ✓ The formulations have been developed by Deflamo in cooperation with customers and partners
- ✓ The method used included changing total PVC formulation:
  - Modifying total formulation, including stabilizers and other additives
  - Replacing Antimony trioxide ( $\text{Sb}_2\text{O}_3$ ) and no phosphate esters or halogens
  - New environmentally friendly plasticiser: Pevalen from Perstorp or widely used DINP
  - Evaluate Apyrum and its synergistic functionality with other flame retardants
  - Formulation ready to use by industry with possible adjustments

# Fire testing and test parameters

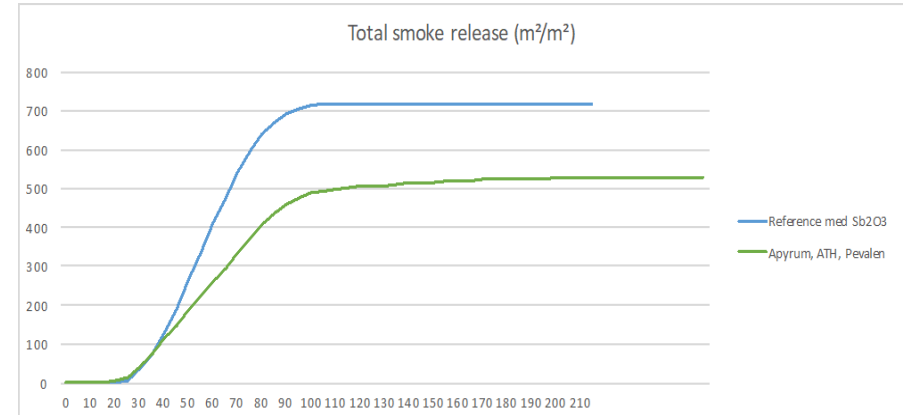
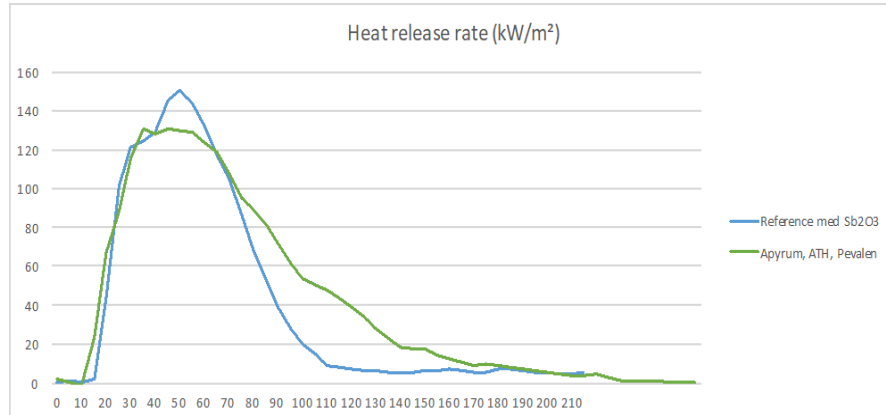
- ✓ Equipment: Cone calorimeter (iCone from Fire Testing Technology Ltd. FTT)
- ✓ Operated by Deflamo AB
- ✓ Size of the sample: 100 mm x 100 mm, thickness: 1,0 mm
- ✓ Surface exposed to heat: 88,4 cm<sup>2</sup>
- ✓ Heat flux: 35 kW/m<sup>2</sup> (ca. 700°C)
- ✓ Distance to sample: 25 mm
- ✓ Horizontal test



Fire Testing Technology Ltd.: iCone

# Product 1: Technical textile

- ✔ Application is soft and strong PVC-coated fabric that passes classification BS2d0 according to Euroclass (EN 13501-1)
- ✔ Our customer is currently using phthalate plasticiser and antimony trioxide ( $\text{Sb}_2\text{O}_3$ ) in the formulation. The objective is to remove these harmful substances
- ✔ The graphs shows the current commercial formulation (reference) in comparison with the new formulation marked “Apyrum, ATH, Pevalen”. Similar of slightly improved heat release, dramatically improved smoke release



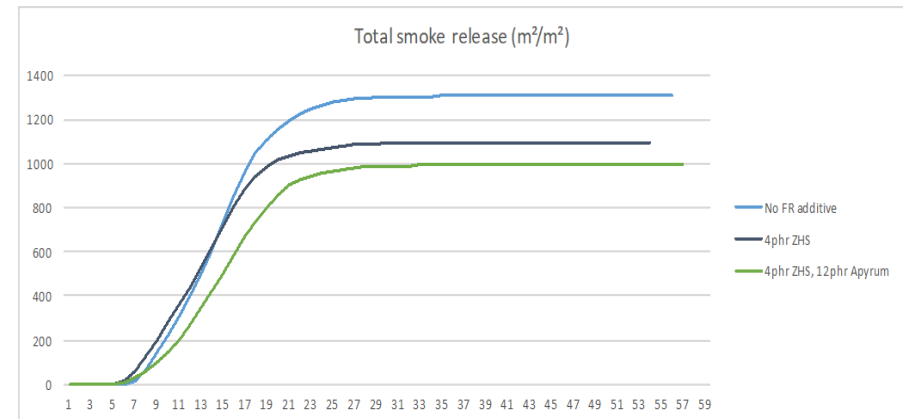
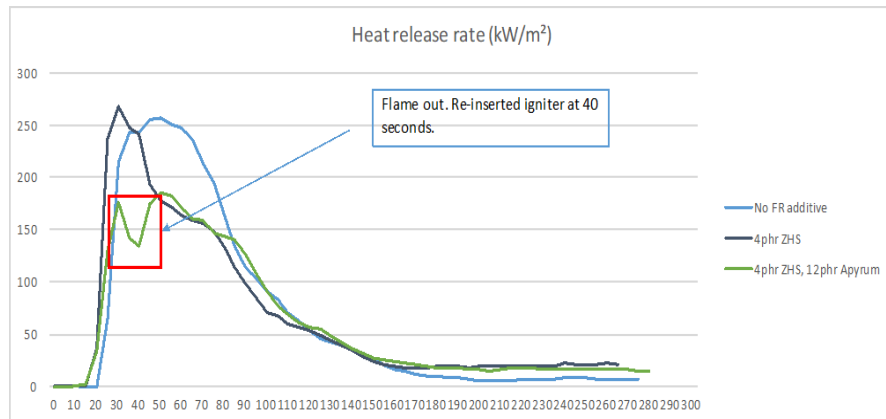
# Product 2: Floor and wall cover

- ✓ Medium soft PVC film produced with calendaring for use in flooring and wall cover applications.
- ✓ High performance regarding fire- and smoke performance. Formulation with widely used plasticiser DINP. Carefully selected components gives very good environmental performance.
- ✓ Graphs Illustrates dramatically improved heat release and flame out. Also synergism between Apyrum and Zinc hydroxy stannate (ZHS)



4 phr ZHS, 12 phr Apyrum

S-PVC	100
Diisononyl phthalate (DINP)	40
ESBO	3
CaZn	3
Apyrum	12
Zinc hydroxystannate (ZHS)	4



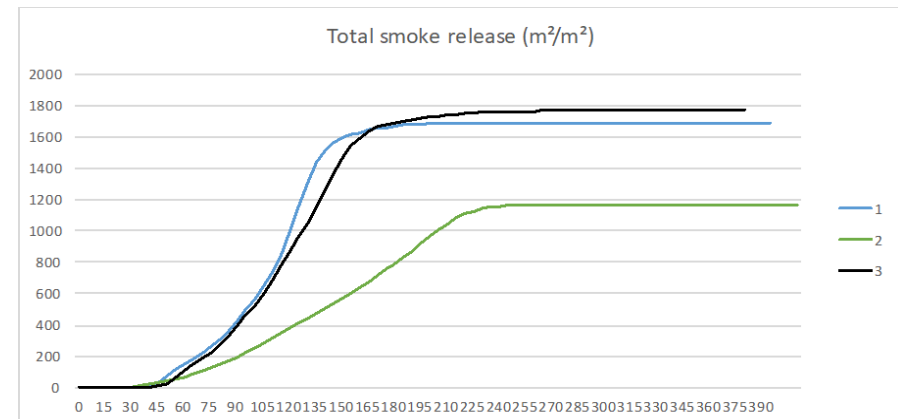
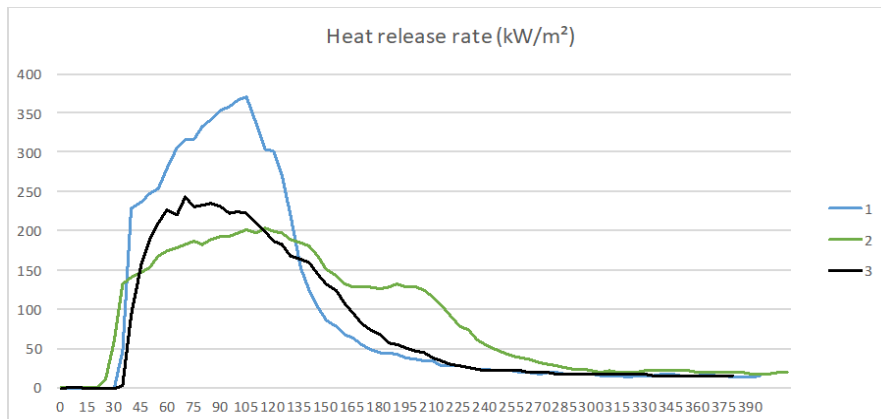
# Product 3: Industrial tarpaulins, tent cloth



- ✔ Plasticised PVC film produced by a coating process for use in reinforced architectural and technical tarpaulins
- ✔ Comparison of three formulation with green plasticiser Pevalen and comparison between flame retardants functionality
- ✔ Formulation 2, with Apyrum and synergists is performing better than formulation 3 whit Antimony (ATO). Formulation 2: Smoke performance is excellent

Formulation 1, 2 and 3

	1	2	3
S-PVC	100	100	100
Pevalen	60	60	60
Apyrum 1002.12	0	5	0
ATO	0	0	12
ZB	0	5	0
ATH	0	25	0



# Conclusions:

- ✔ Three product samples based on formulations that can substitute toxic and harmful flame retardants with similar or better fire performance
- ✔ The combination of environmentally sound formulation in combination with high flame retardancy is possible
- ✔ Data from cone calorimetry illustrates:
  - Apyrum is adding functionality and value to commercial applications
  - Apyrum and Pevalen functions well in combination
  - Possible to exclude ATO and Phosphate esters and still meet highest flame retardancy requirements
  - Apyrum outperforms ATO regarding smoke release
  - Apyrum is synergistic with ATH and ZHS and more

*This data and information is presented by Deflamo and tests and samples are based upon samples prepared by Deflamo and or partners / customers. Fire tests is made by Deflamo as a part of customer development projects and some detailed information is excluded to not infringe the rights of other parties. Fire testing is not verified by third party fire lab.*