Low VOC stabilization systems for PP automotive applications

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It's all about **the chemistry™**

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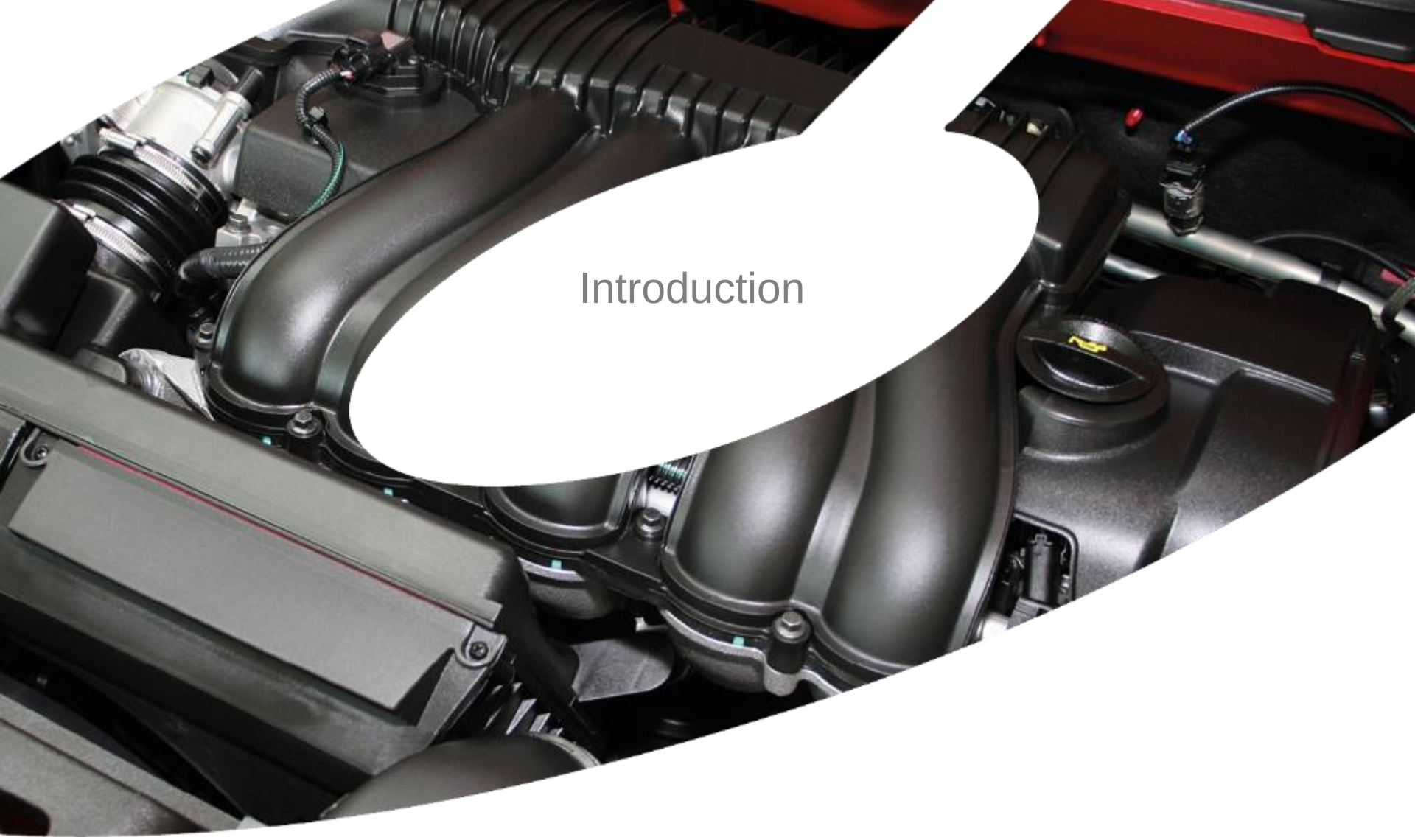
About SONGWON Industrial Group

Founded in 1965, SONGWON is **headquartered in Ulsan, South Korea** and operates group companies all over the world.

Our clients benefit from a **global framework** combined with readily accessible local organizations, including customer service offices and technical support centers in numerous different countries.

It's all about **the chemistry™**

SONGWON's claim, "It's all about the chemistry", purposely combines the human aspect with our credibility in chemistry. It has a double meaning, **building on human and product chemistry**.



Introduction

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Introduction

Since many years the automotive industry has been chasing volatile organic compounds (VOC)

- VDA 278 norm is in place since more than 15 years
- All actors in the automotive value chain are involved to **reduce VOC**
- Some solutions are costly and do not always meet **margins expectations**

This presentation focuses on 2 examples how resin producers and compounders can increase the profitability of their low VOC grades.

Case 1: Polypropylene producers

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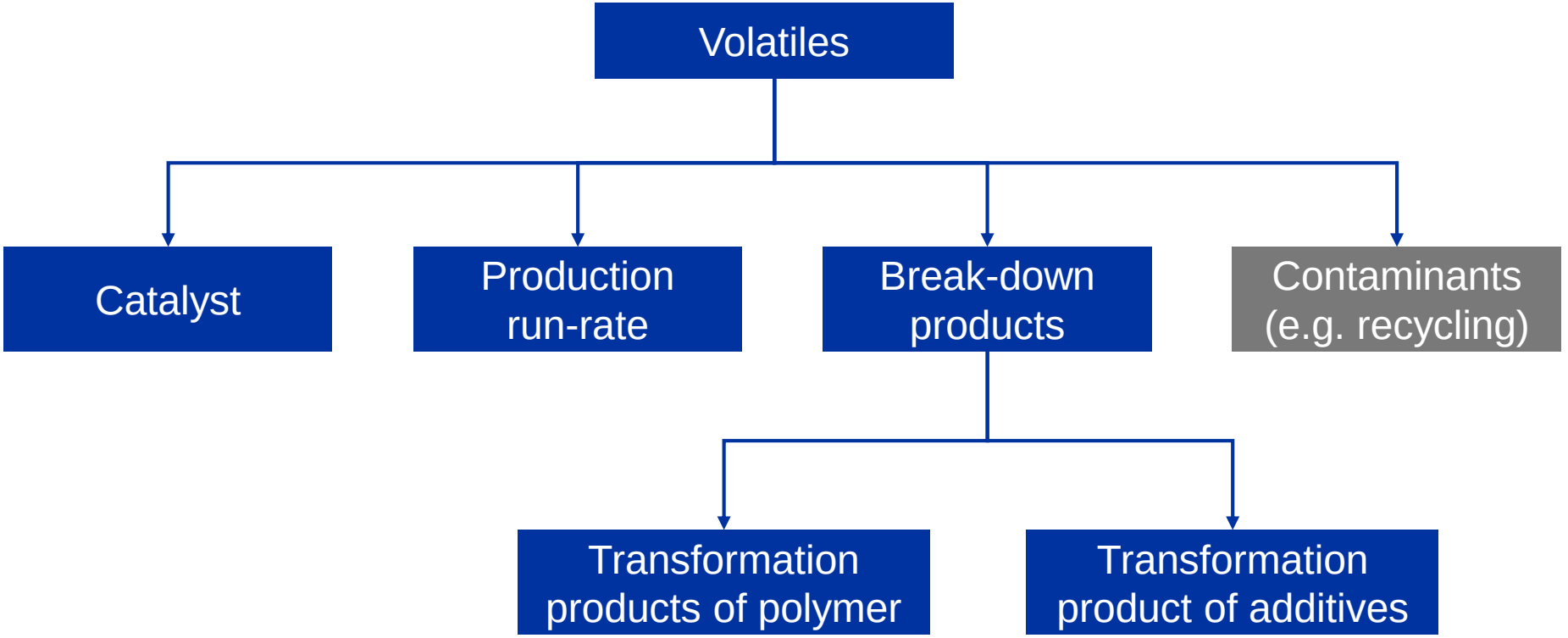
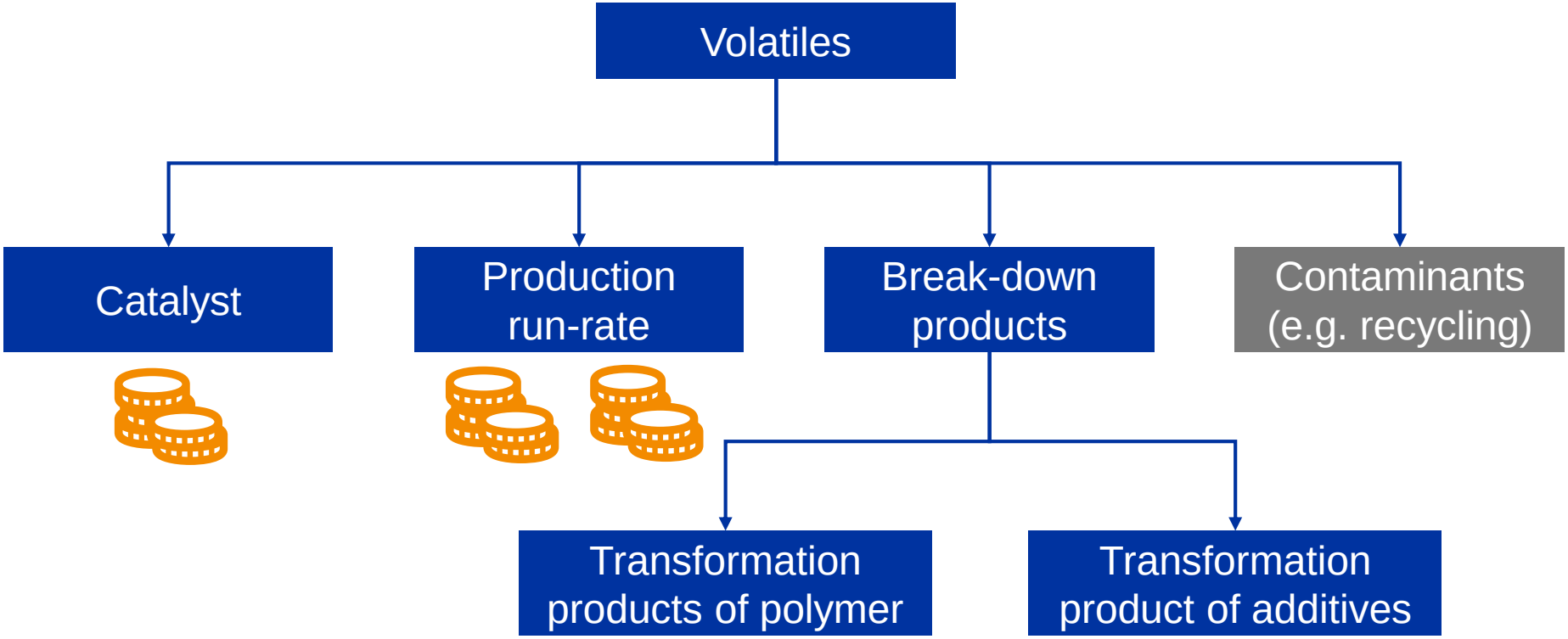
Origin of emissions – various origins of volatiles (VOC)

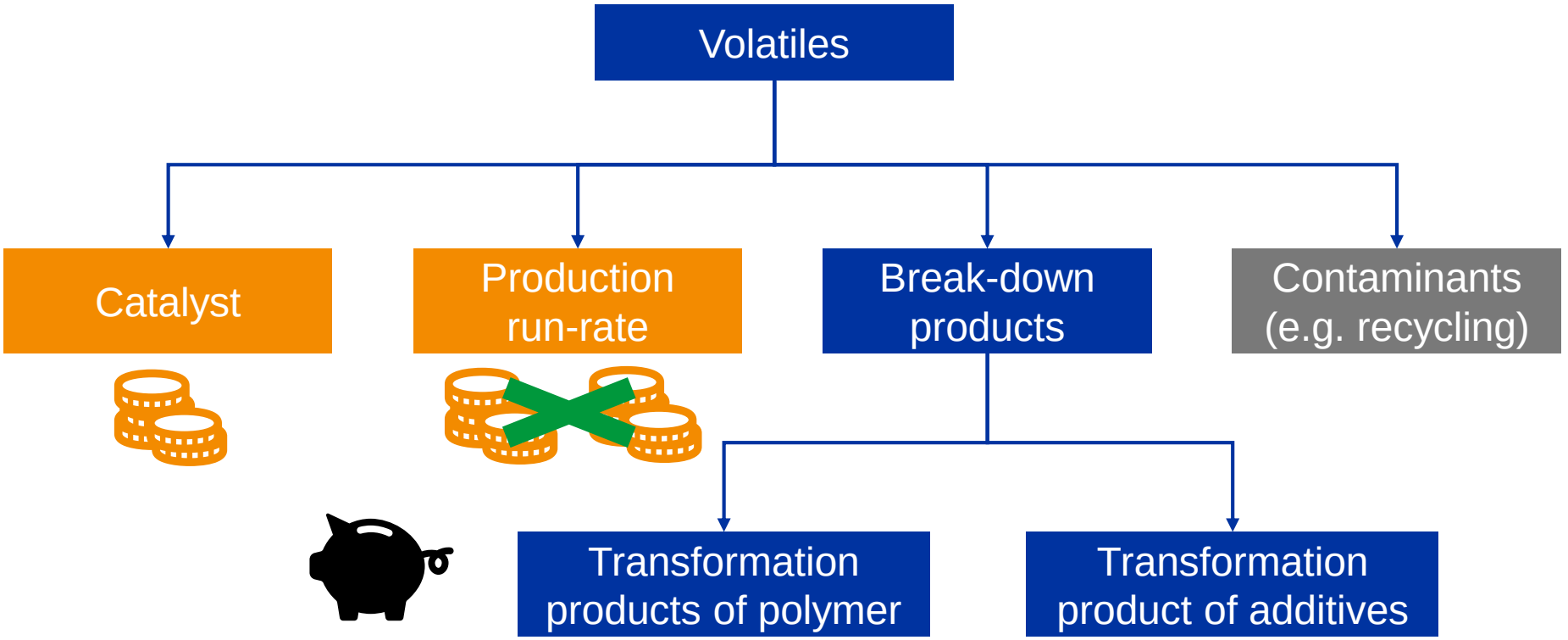


Most resin producers focused on catalyst and run-rate to reduce VOC



Reducing production run-rate proofed to **reduce VOC**, however, it could **affect product profitability** significantly

Most resin producers focused on catalyst and run-rate to reduce VOC



The right additivation solution can support VOC reduction allowing to increase the production run-rate

Processing stabilization of polypropylene

Standard stabilization systems

- Combination of [hindered phenol + phosphite] - “binary blend”
- Higher long term thermal stability (LTTS) contribution of hindered phenol required due to higher LTTS (test) temperature and higher melting behavior
- Higher LTTS requirements (in durable applications)

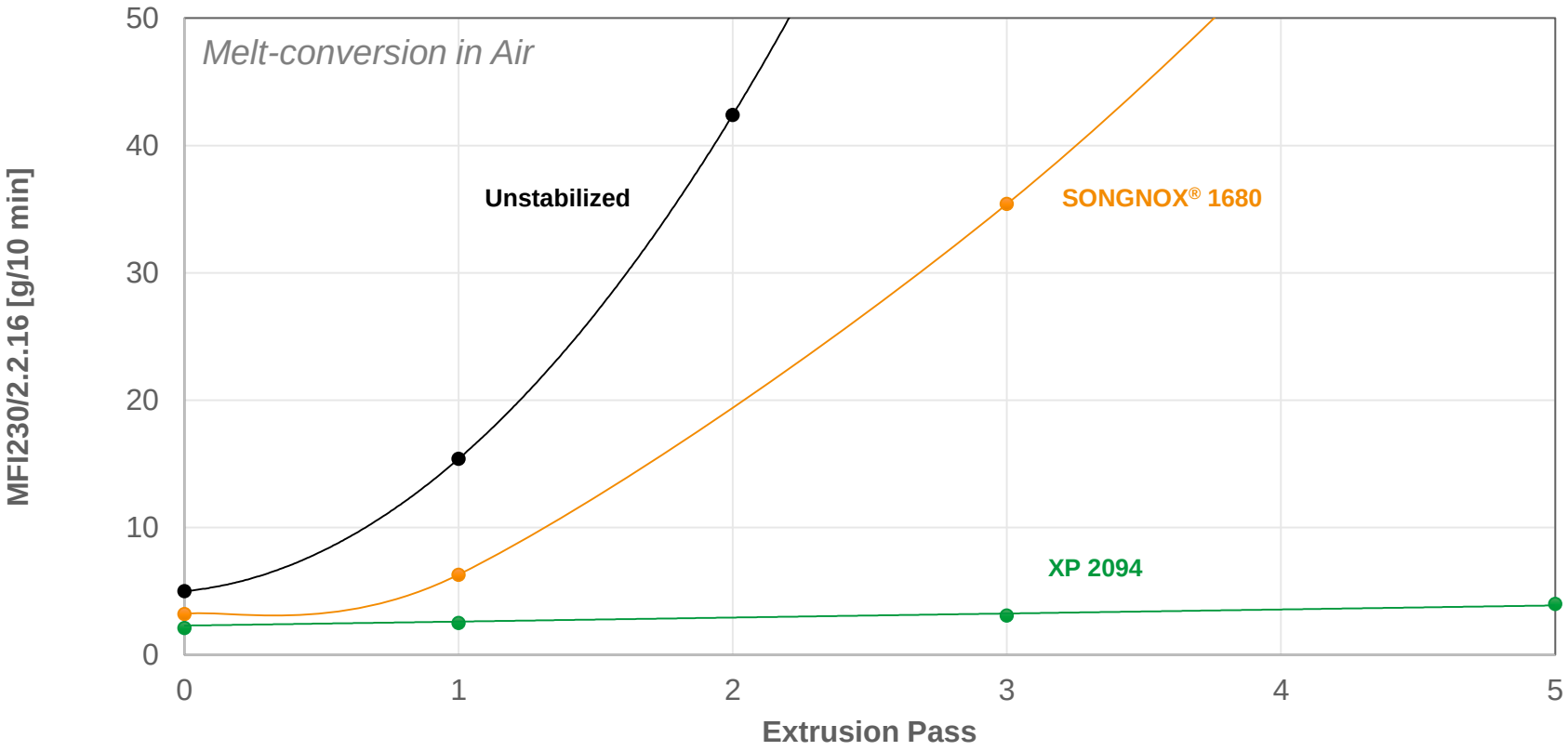
[hindered phenol + phosphite]

SONGNOX® 1010 or SONGNOX® 1330 SONGNOX® 3114	SONGNOX® 1680 or SONGNOX® 6260 SONGNOX® PQ
• Moderate “thermal” stabilizer • Reasonable balance between contribution to LTTS and processing	• Mono-phosphite (one P center) • Synergistic co-stabilizer for processing & moderate color regulator

Requirements of stabilizer next to low VOC performance

- Processing stability
- Long term thermal stability (service life)
- Optimum synergism between stabilizers
- Indirect food contact approval
- Secondary effect (discoloration, compatibility, hydrolysis, break-down products etc.)
- Cost

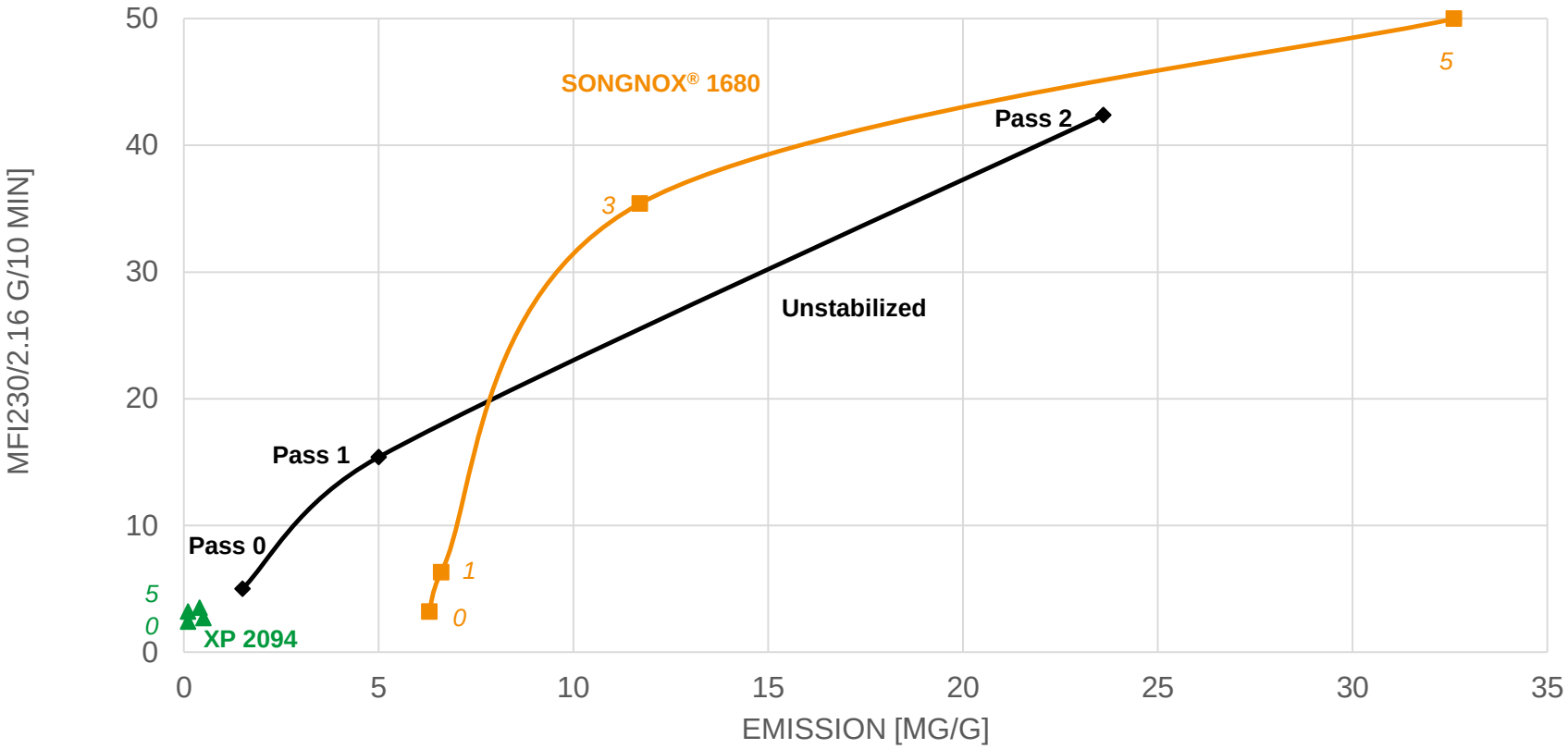
Processing stabilization of polypropylene



Substrate:	PP homopolymer	*Criteria:*	$MFI_{230/2.16}$ versus extrusion pass 5
Compounding:	N_2, 215°C, TS	*Stabilization:*	750 ppm CaSt
Extrusion:	MPE air 255°C, SS		1000 ppm Processing Stabilizer as indicated
Sample:	Granules	*Pigmentation:*	Un-pigmented

Processing stabilization of polypropylene

… and formation of VOC (VDA 278)

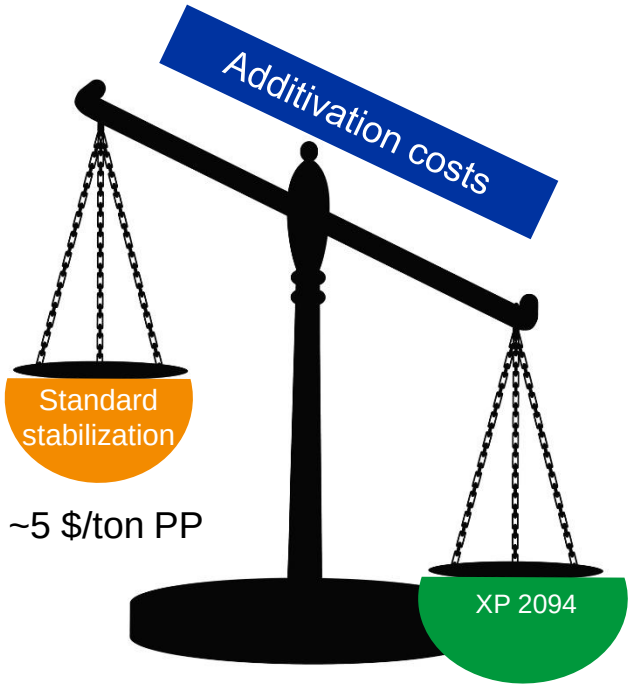


Substrate:	PP homopolymer (bulk polymerization) $MFI_{230/2.16}$ ~ 6 [dg/min]	*Criteria:*	$MFI_{230/2.16}$ versus VOC (VDA 278) of compound
Compounding:	N_2, 215°C, TS	*Stabilization:*	750 ppm CaSt + Thermal Stabilizer as indicated
Sample:	1.6 mm injection molded plaques / granules		

Experimental stabilizer XP 2094

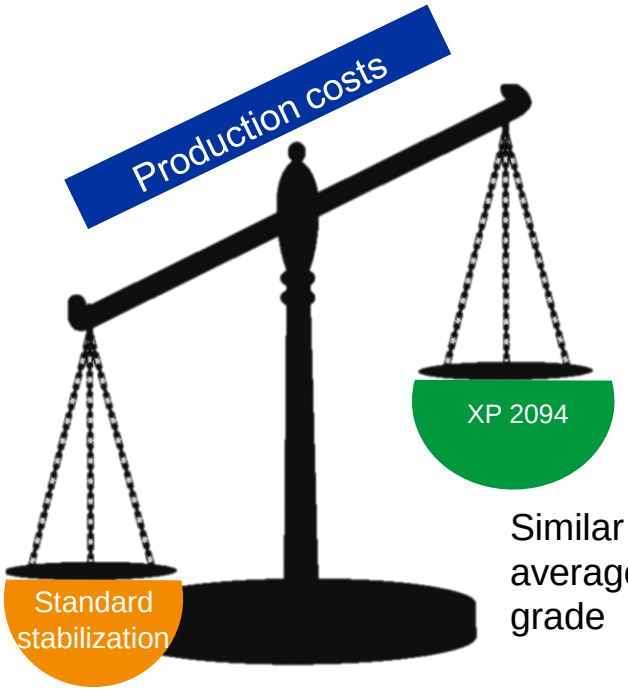
- Optimum synergistic formulation
- Excellent processing stability
- Moderate long term stability
- Better color stability
- Broad Indirect food contact approval
- Excellent contribution to low VOC

XP 2094 can increase profitability of low VOC grades



~5 $/ton PP

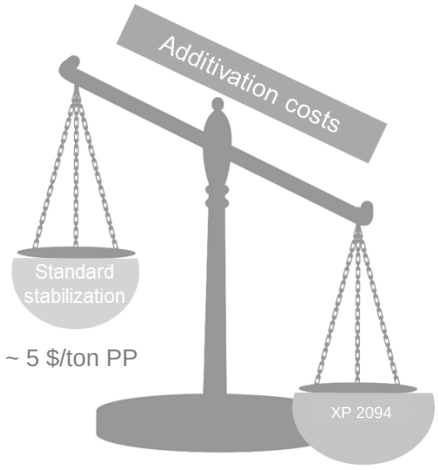
~30 $/ton PP



Similar to average plant grade

~ 90 $/ton PP higher than average plant grade

XP 2094 can increase profitability of low VOC grades



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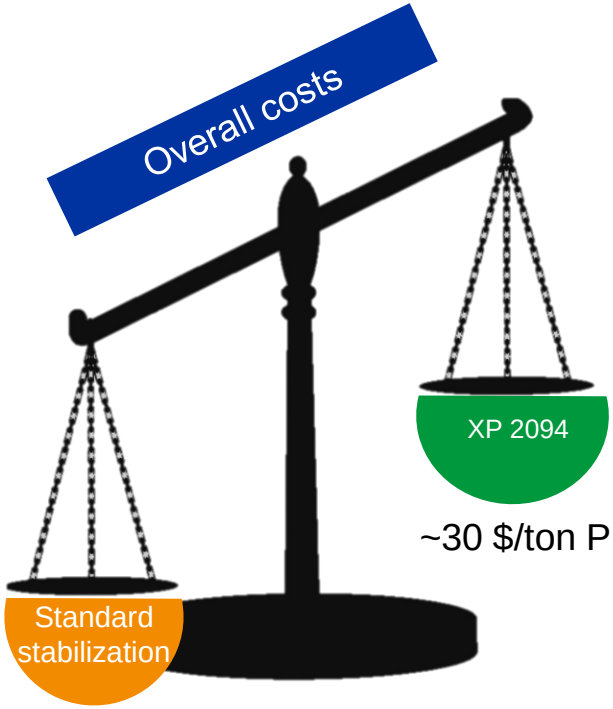
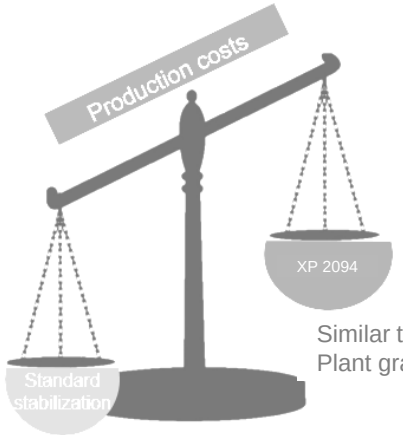


~30 $/ton PP

~ 95 $/ton PP



Similar to average Plant grade

~ 90 $/ton PP higher than average plant grade

Case 2: Compounders

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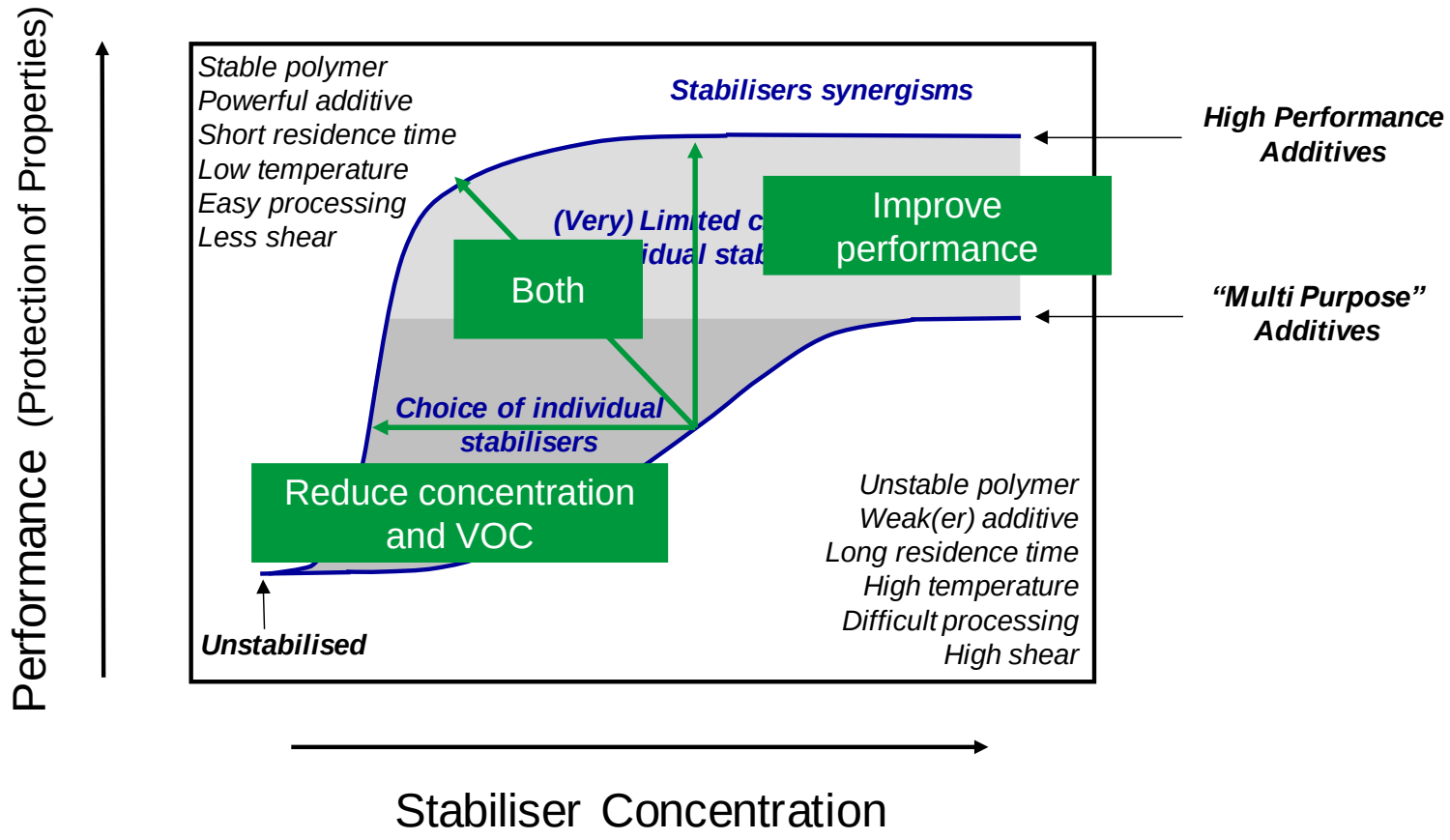
VOC in automotive compounds

VOC source ☹ low ☹☹☹ high	Short glass fibers	Long glass fibers	Natural fibers	Carbon fibers
Resin	☹	☹	☹	☹
Process	☹☹	☹☹☹	☹	☹
Filler & coupling agent	☹☹	☹	☹☹☹	☹

In all cases, AOs can help to decrease the total VOC level

Performance requirements of stabilizers

Tailor-made versus multi-purpose stabilizer packages

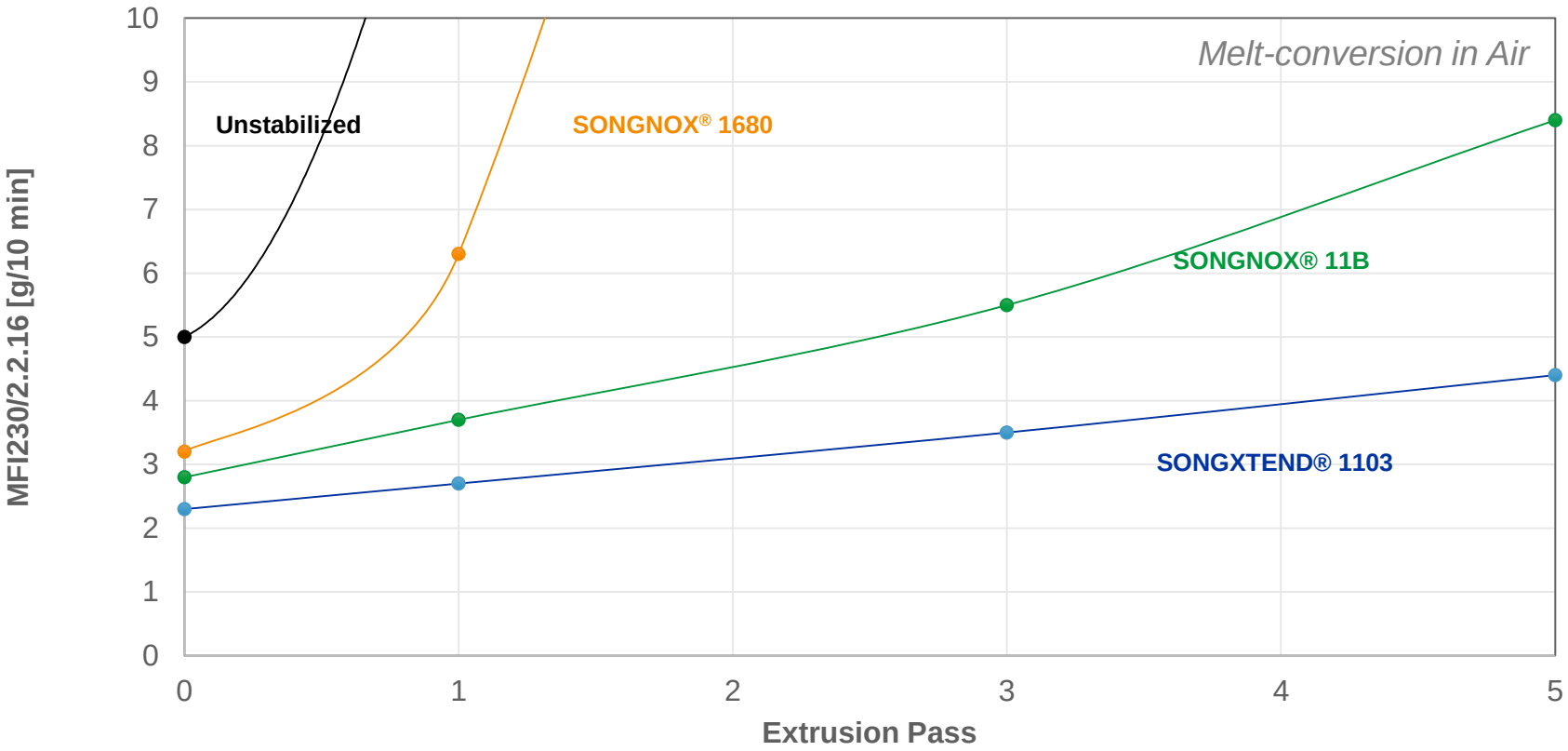


Automotive compounding

SONGXTEND® 1103 stabilizer

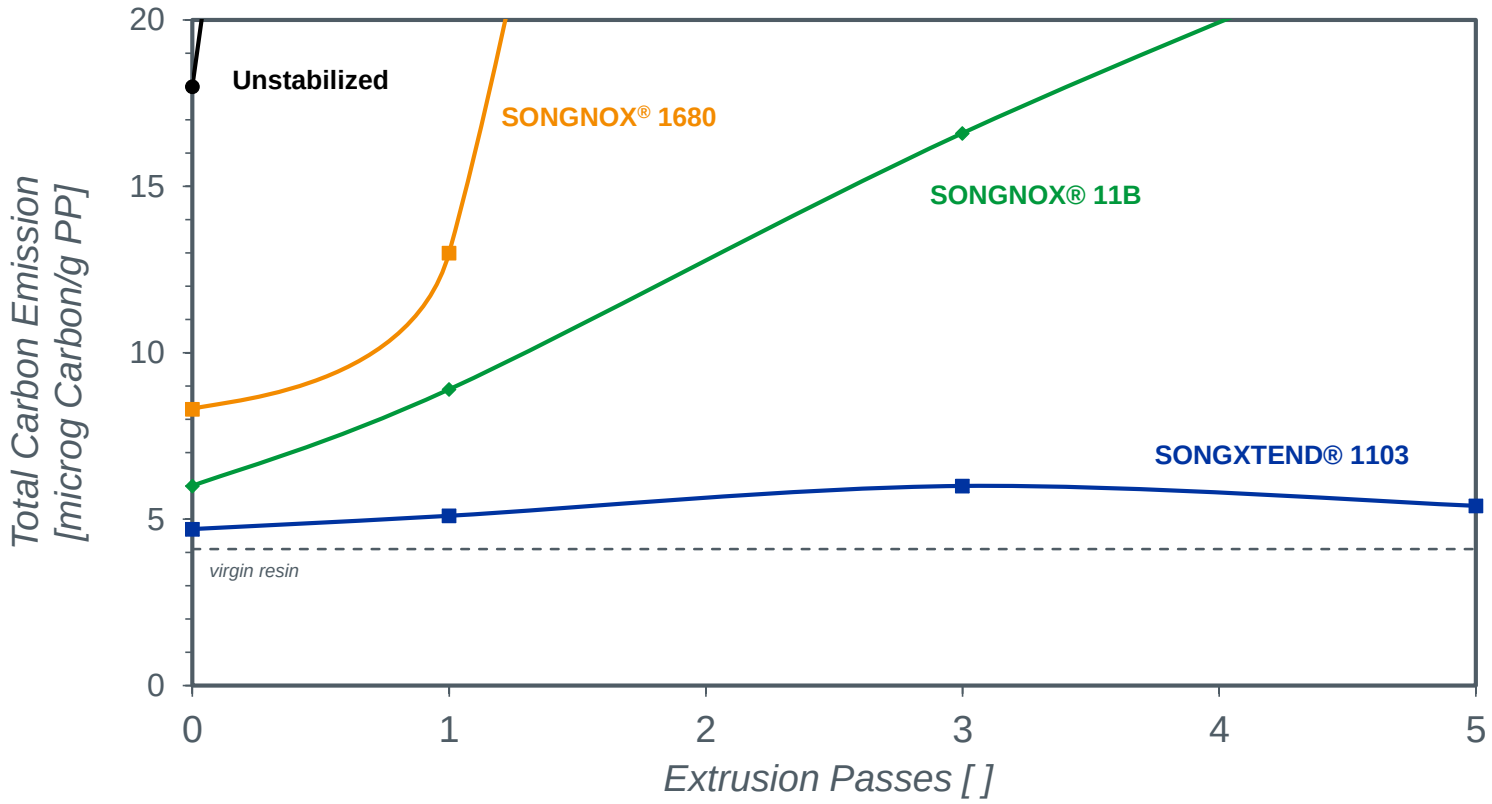
- Automotive compounding is a very aggressive process
  - Extreme heat
  - Very high shear, more or less severe depending of the filler
- Processing stability needs to be boosted
- Standard mono-phosphite stabilizers are less performing and therefore contribute less to VOC reduction
- SONGWON developed SONGXTEND® 1103
  - Prevents polymer degradation. Less low molecular-weight chains are formed that can increase VOCs

Our offering for demanding compounding



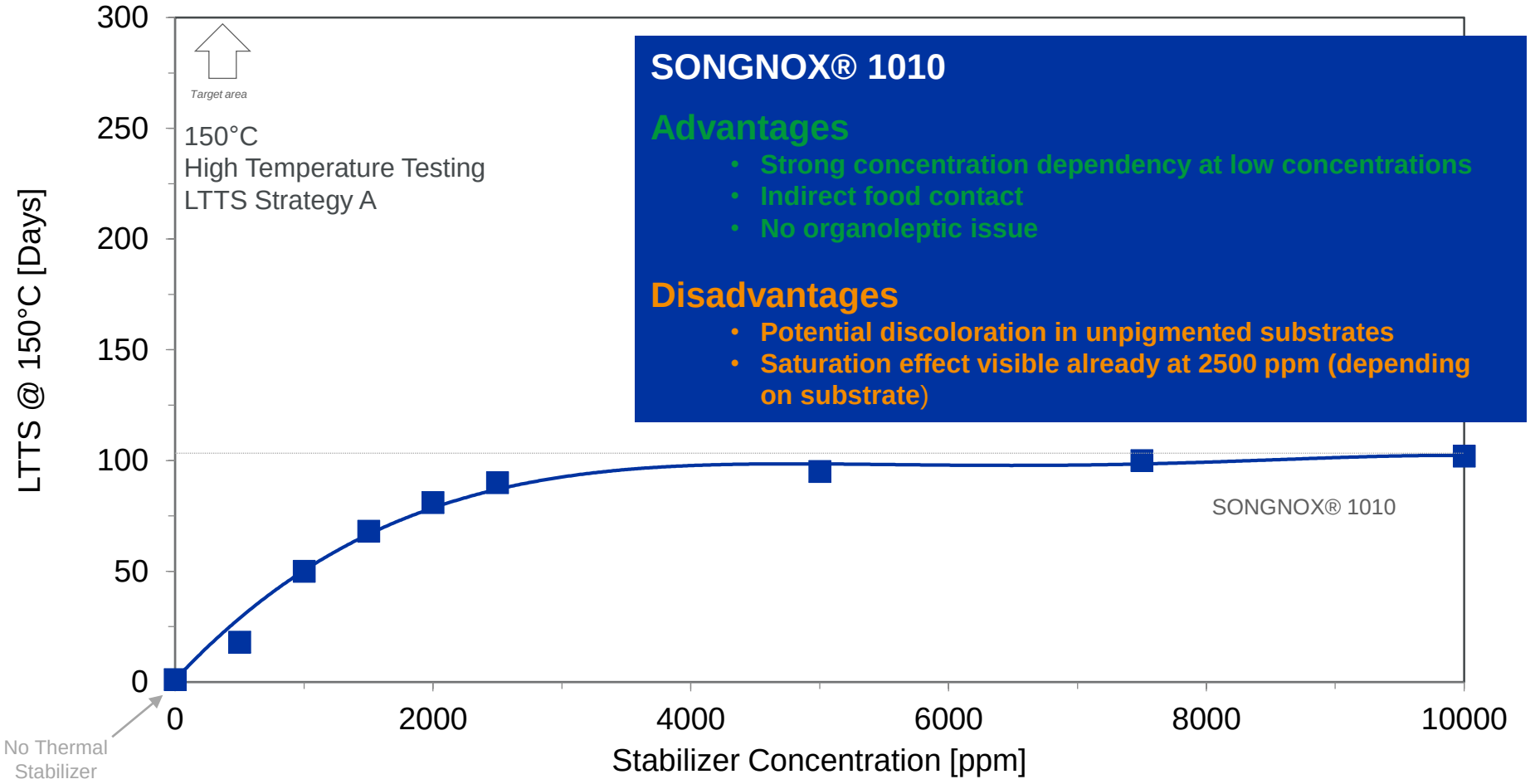
Substrate:	PP homopolymer	*Criteria:*	$MFI_{230/2.16}$ versus extrusion pass 5
Compounding:	N_2, 215°C, TS	*Stabilization:*	750 ppm CaSt +
Extrusion:	MPE air 255°C, SS		1000 ppm Processing Stabilizer as indicated
Sample:	Granules	*Pigmentation:*	Un-pigmented

Our offering for demanding compounding



Substrate:	PP homopolymer	*Criteria:*	Total carbon mission (VW PV 3341 or VDA 277) vs. extrusion pass
Compounding:	N_2, 215°C, TS	*Stabilization:*	750 ppm CaSt + 1000 ppm Processing Stabilizer as indicated
Extrusion:	MPE air 255°C, SS	*Pigmentation:*	Un-pigmented
Sample:	Granules		

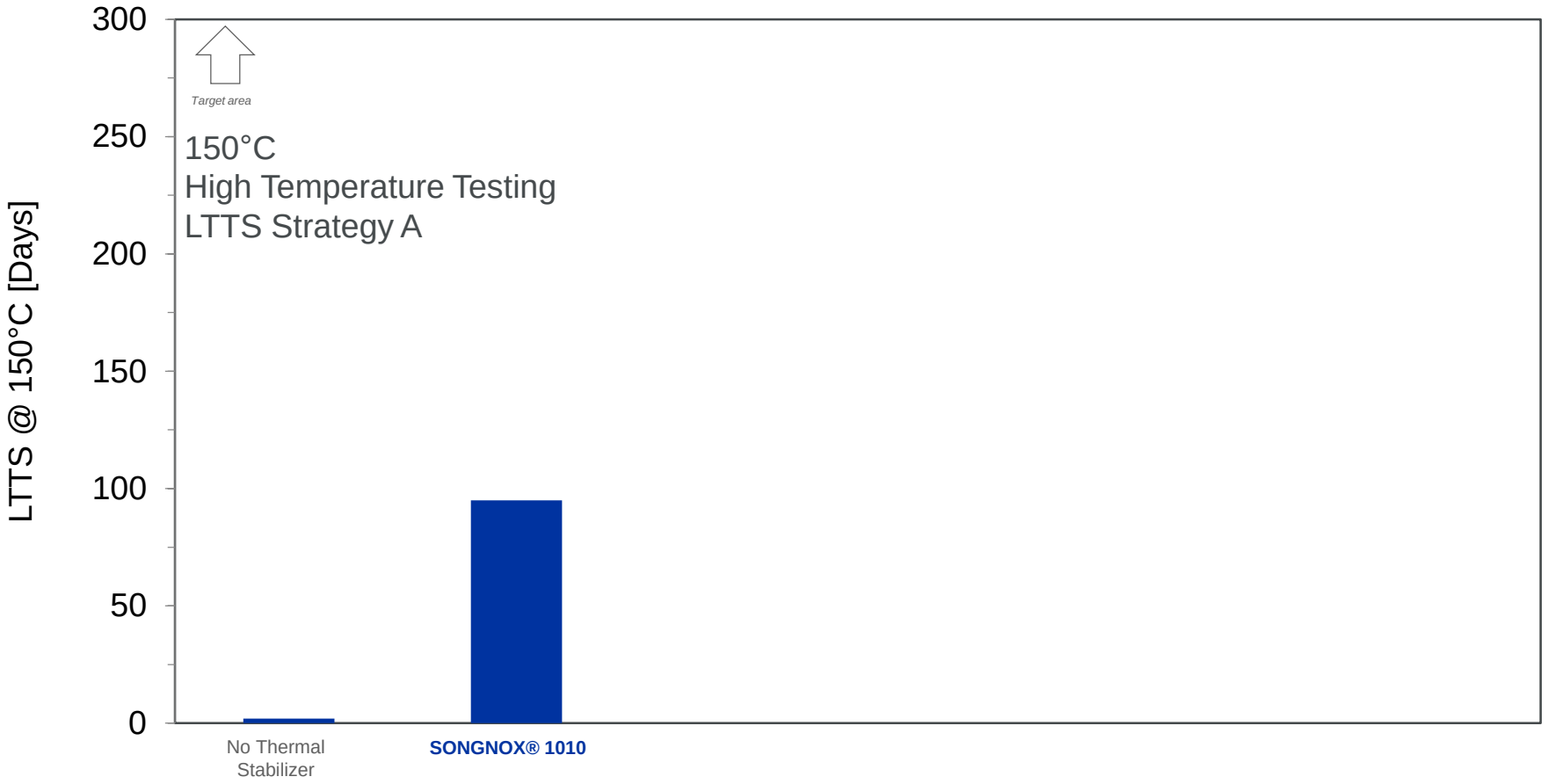
General purpose LTTS strategy



Substrate: PP homopolymer (bulk polymerization)

Criteria: Exposure at 150°C in air
Stabilizer concentration versus embrittlement time

General purpose LTTS strategy



Substrate:	PP homopolymer (bulk polymerization)
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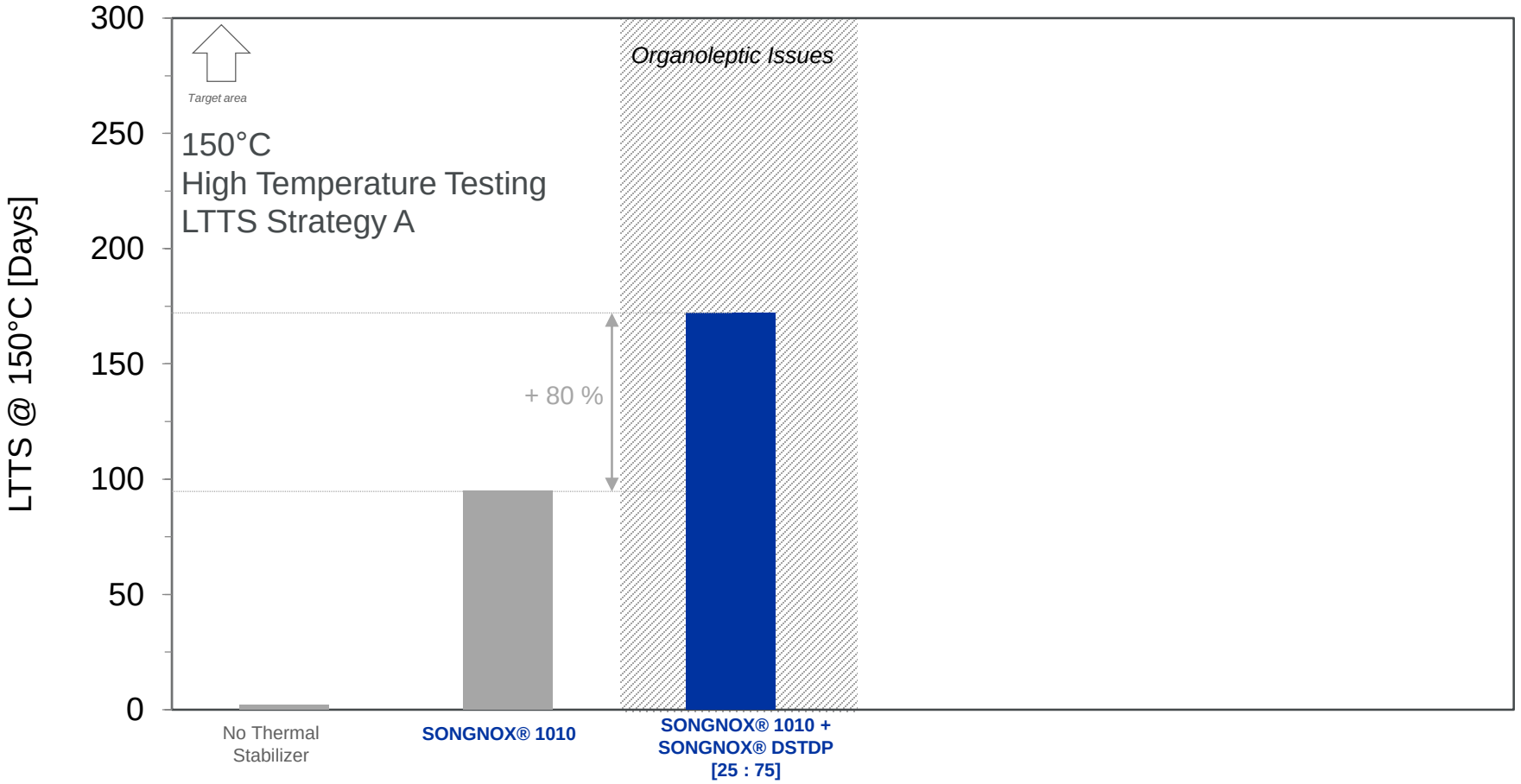
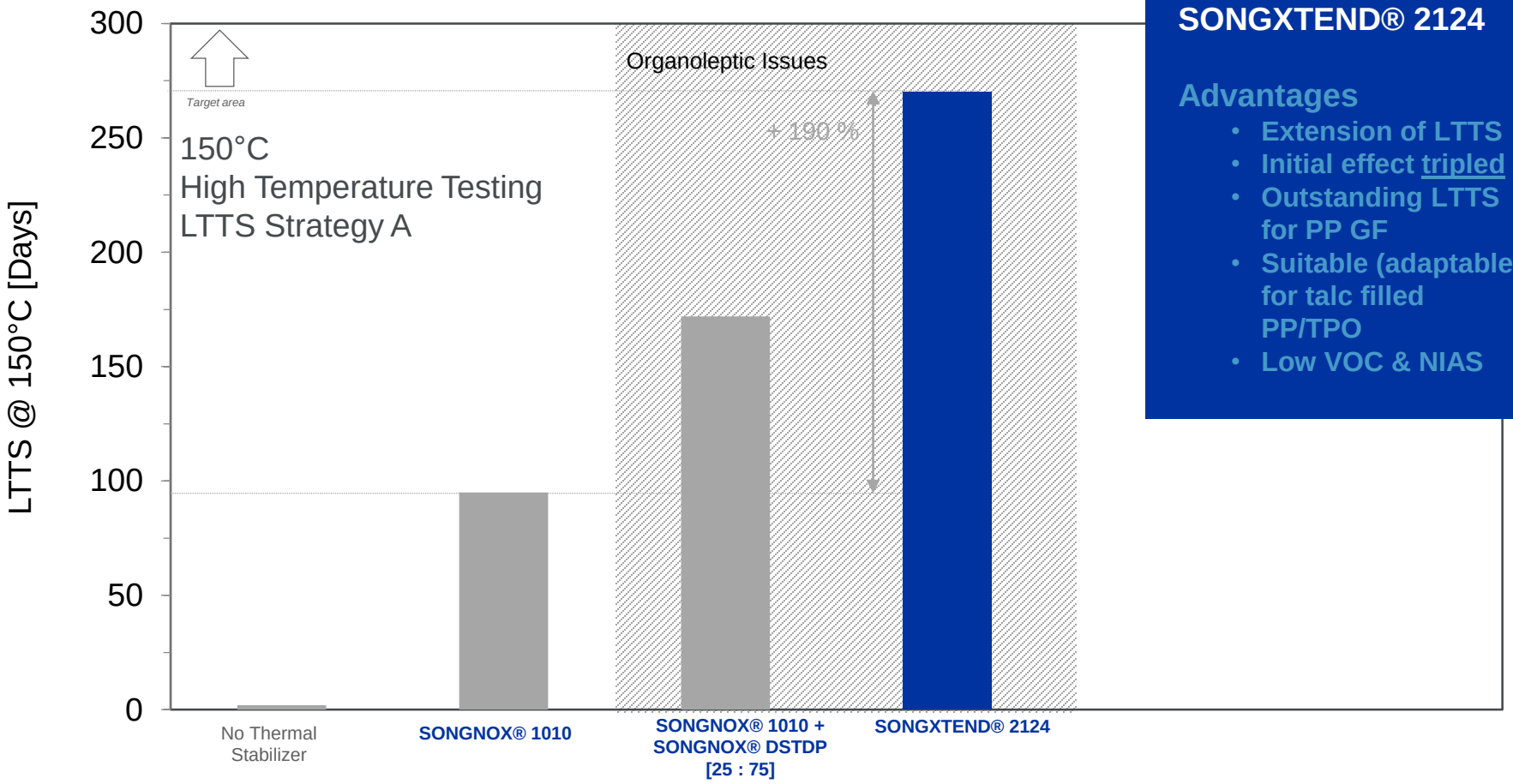
General purpose LTTS strategy



Substrate: PP homopolymer (bulk polymerization)
Criteria: Exposure at 150°C in air
Stabilizer concentration versus embrittlement time

SONGXTEND® 2124 – best LTTS in industry



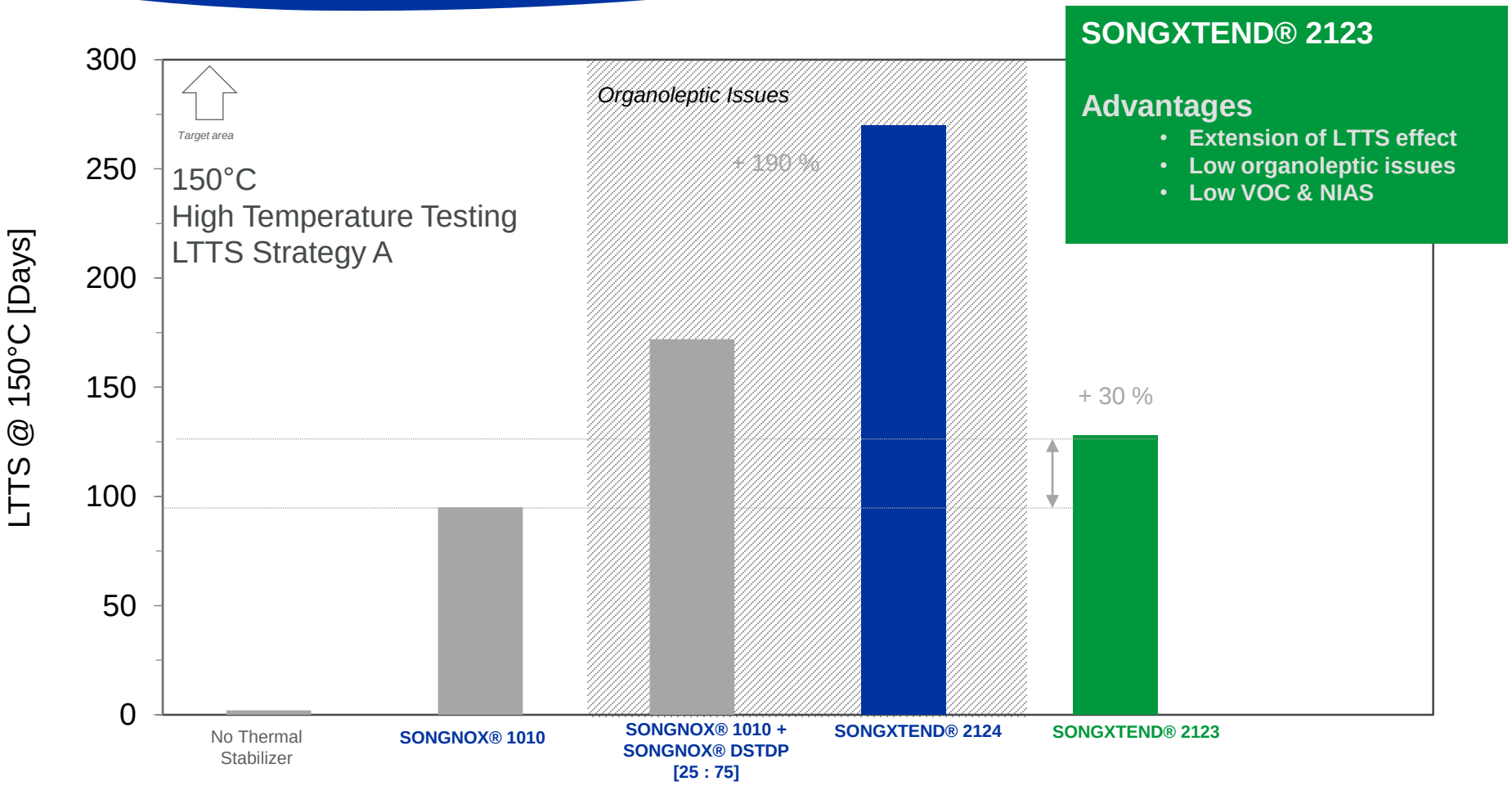
SONGXTEND® 2124

Advantages

- **Extension of LTTS**
- **Initial effect tripled**
- **Outstanding LTTS for PP GF**
- **Suitable (adaptable) for talc filled PP/TPO**
- **Low VOC & NIAS**

Substrate:	PP homopolymer (bulk polymerization)
Criteria:	Exposure at 150°C in air
	Stabilizer concentration versus embrittlement time

SONGXTEND® 2123 – alternative “school of thought”

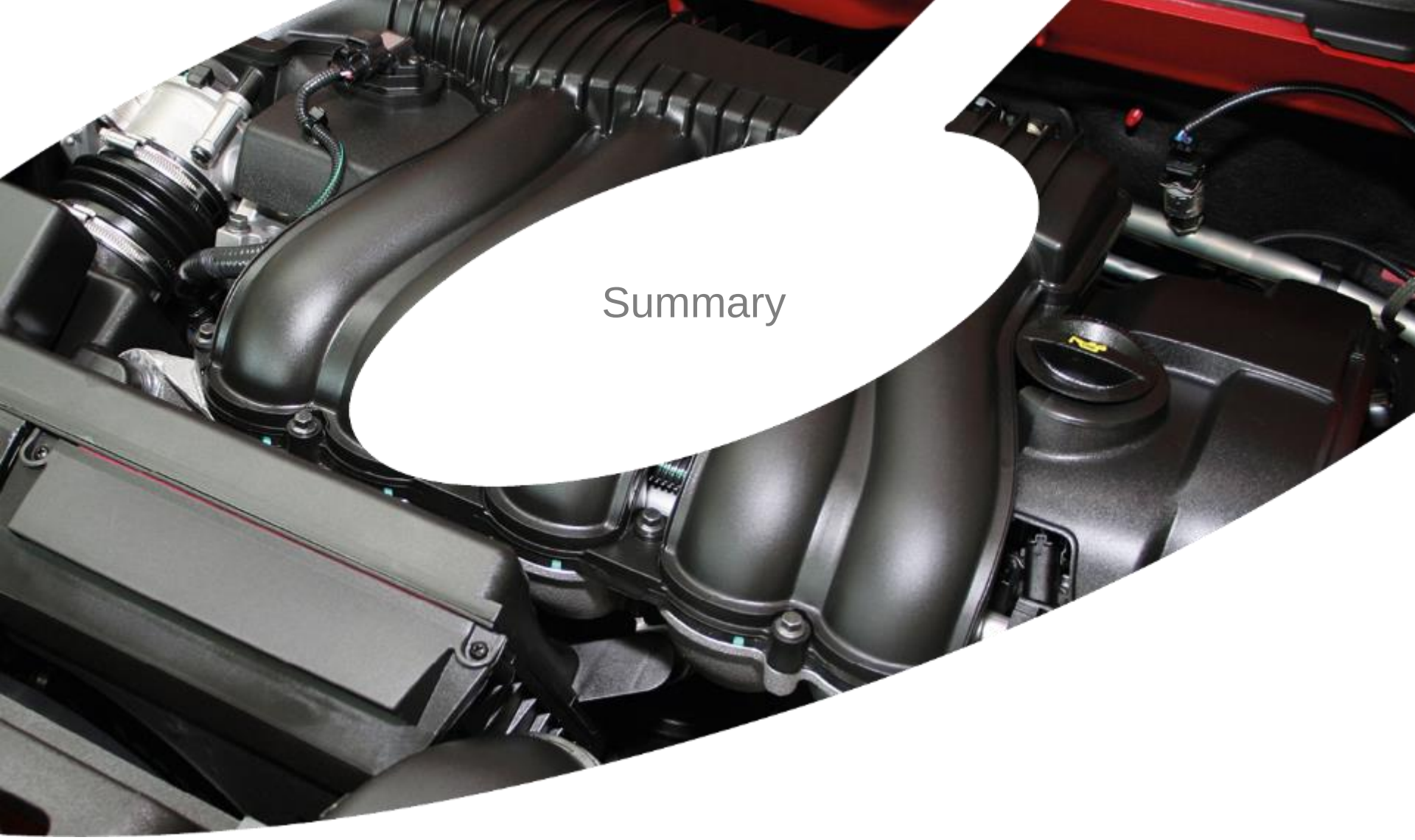


SONGXTEND® 2123

Advantages

- **Extension of LTTS effect**
- **Low organoleptic issues**
- **Low VOC & NIAS**

Substrate: PP homopolymer (bulk polymerization)
Criteria: Exposure at 150°C in air
Stabilizer concentration versus embrittlement time



Summary

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One solution for each application

	Under-the-hood	Interior automotive
Processing stabilization	Standard stabilization	XP2094 SONGXTEND® 1103
Thermal stabilization	SONGXTEND® 2124	SONGXTEND® 2123

Summary

To reduce VOC of PP compounds

- Favor low VOC PP grades containing a highly efficient processing stabilizer like **XP2094** experimental stabilizer
- Carefully select the filler you use
- Use **SONGXTEND® 1103** stabilizer for demanding compounding conditions
- Add **SONGXTEND® 2123 or SONGXTEND® 2124** stabilizer as a long-term heat stabilizer

Thank you for your attention

JungDu (Jack) Kim

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