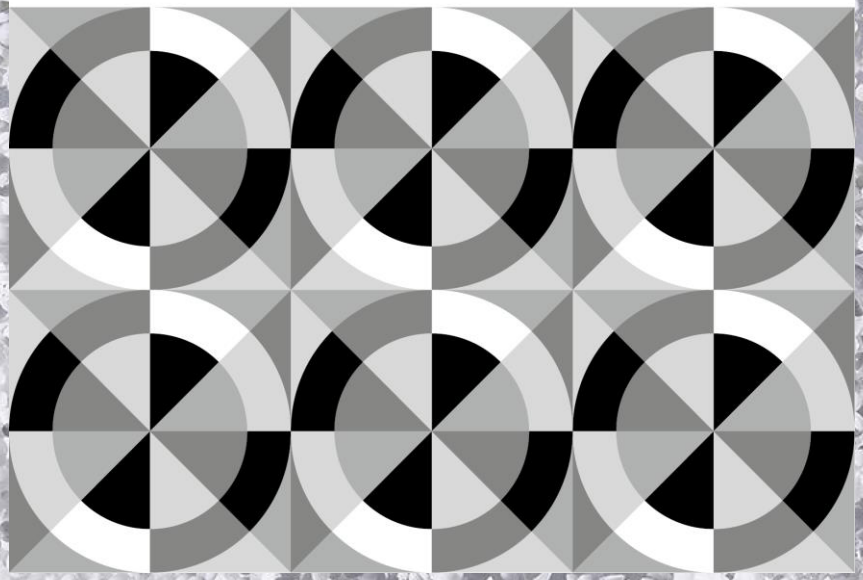
High performance stabilizer with enhanced hydrolytic stability and reduced NIAS

A blend of passion and technology
ADDWORKS®



CLARIANT

Confidential

Dr. Hartmut Siebert, MSc
BU Additives
BL Performance Additives
17.01.2019

what is precious to you?

CLARIANT

Table of Contents

CLARIANT

Clariant History

Clariant

1995

Clariant Swiss parent company created in a spin-off and subsequent IPO of the Sandoz Chemicals Division

1997

Acquisition of **Hoechst AG** specialty chemicals business

2000

Acquisition of **British BTP**

2001 – 2007

Divestment of several bigger businesses due to financial difficulties resulting from BTP acquisition

2006

Acquisition of **Ciba Masterbatches**
Divestment of **Pharmaceutical Fine Chemicals**

2008

Change in **management**

2009

Launch of **Clariant Excellence**

2009 – 2010

Restructuring phase

2011

Acquisition of **Süd-Chemie**
Roll-out of new Clariant **Corporate Values**

CLARIANT

2012

Clariant rebranding
Introduction of new corporate mission and vision

2013

Opening **Clariant Innovation Center** in Frankfurt, Germany

2013 – 2014

Divestment of 5 businesses

2014

Sustainability becomes strategic pillar

2015

Establishment of **Global Business Services**
Clariant celebrates **its 20th birthday**

2016

Acquisition of **Kel-Tech** and **X-Chem** in the U.S.

2017

Announcement of planned **merger with Huntsman**

White Tale Holdings steps in

Termination of merger

Strategy update started

2018

SABIC becomes Clariant's biggest shareholder by acquiring the stake of White Tale

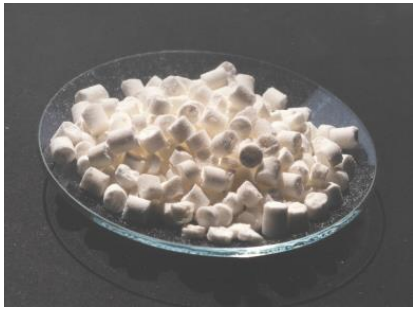
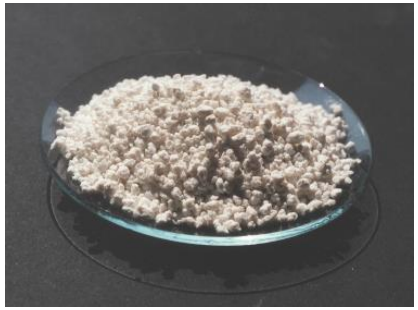
Clariant and **SABIC** sign memorandum of understanding and governance agreement

1995 2000 2006 2011 2012 2015 2017 2018

CLARIANT

AddWorks Solutions

- A unique combination of a differentiated chemical formulation offered in the most-convenient-to-handle physical form.
- Solutions developed by Clariant Polymer Additives to satisfy specific market needs.
- By leveraging on Clariant`s products, expertise, know-how, production capabilities, AddWorks remove complexity and cost at our customers.

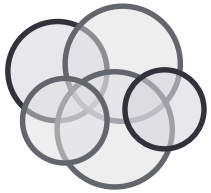





CLARIANT

Fully integrated approach to provide customer specific performance

- **Low migration**
- **Superior colour**
- **Low gel formation**
- **Enhanced metallisation**
- **Enhanced melt stability**
- **Low water carry over**
- **In-process cleaning**
- **Excellent hydrolytic stability**
- **Enhanced pressure pipe life-time**
- **Cost efficiency**

AddWorks LXR 5 solutions



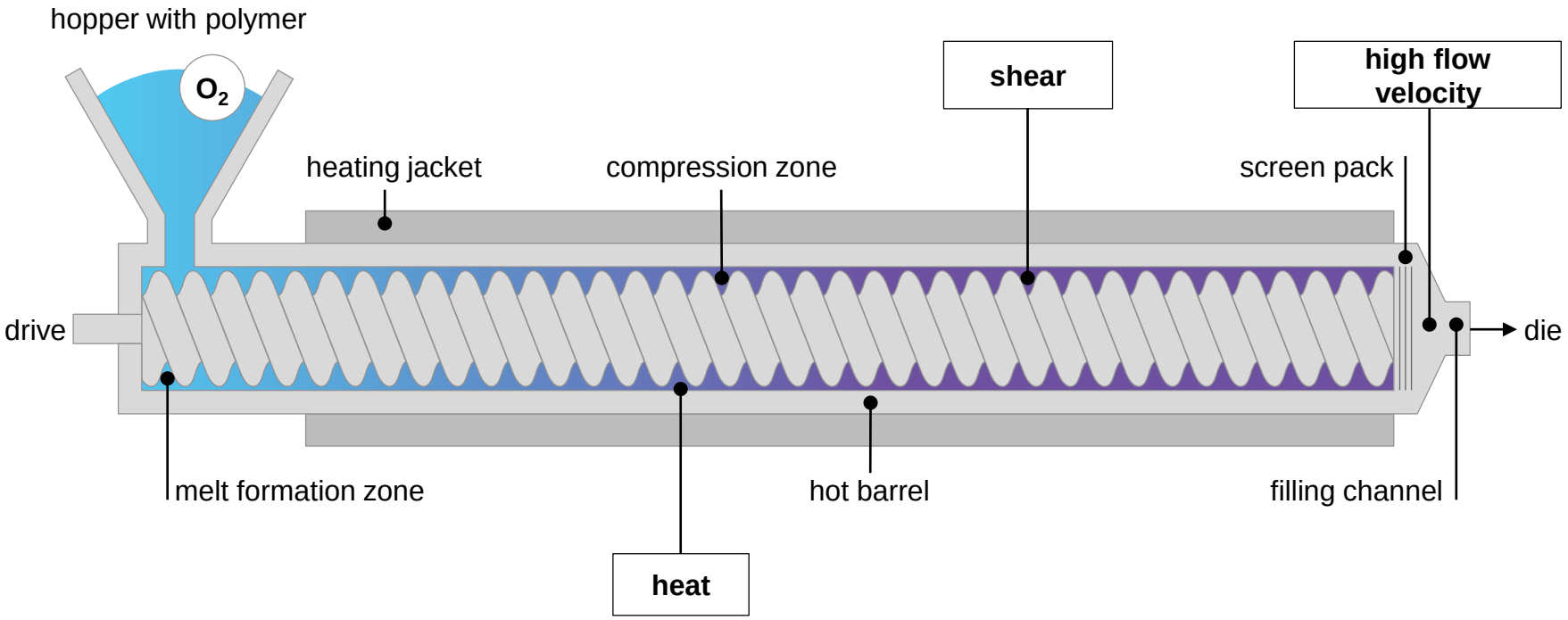
Customer specific benefits in a **fully integrated** way.

Benefits for extrusion process

what is precious to you?

CLARIANT

Melt formation and extrusion



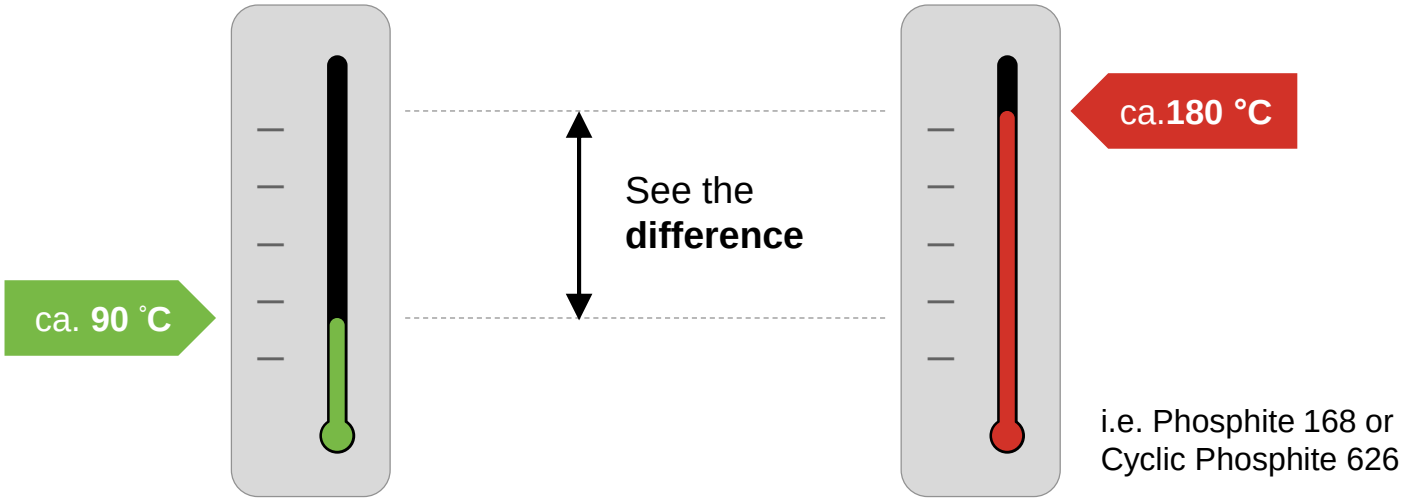
Several **critical zones** for polymers in the **extrusion process**

CLARIANT

Addworks LXR 568 is activated early during plastic processing and efficiently protecting the resin melt

Softening temperature interval AddWorks LXR 568

Typical melting point of single stabilizer



The low melting temperature of AddWorks LXR 568 contributes to a superior **melt homogeneity** and an efficient **reduction of gels and defects** in films.

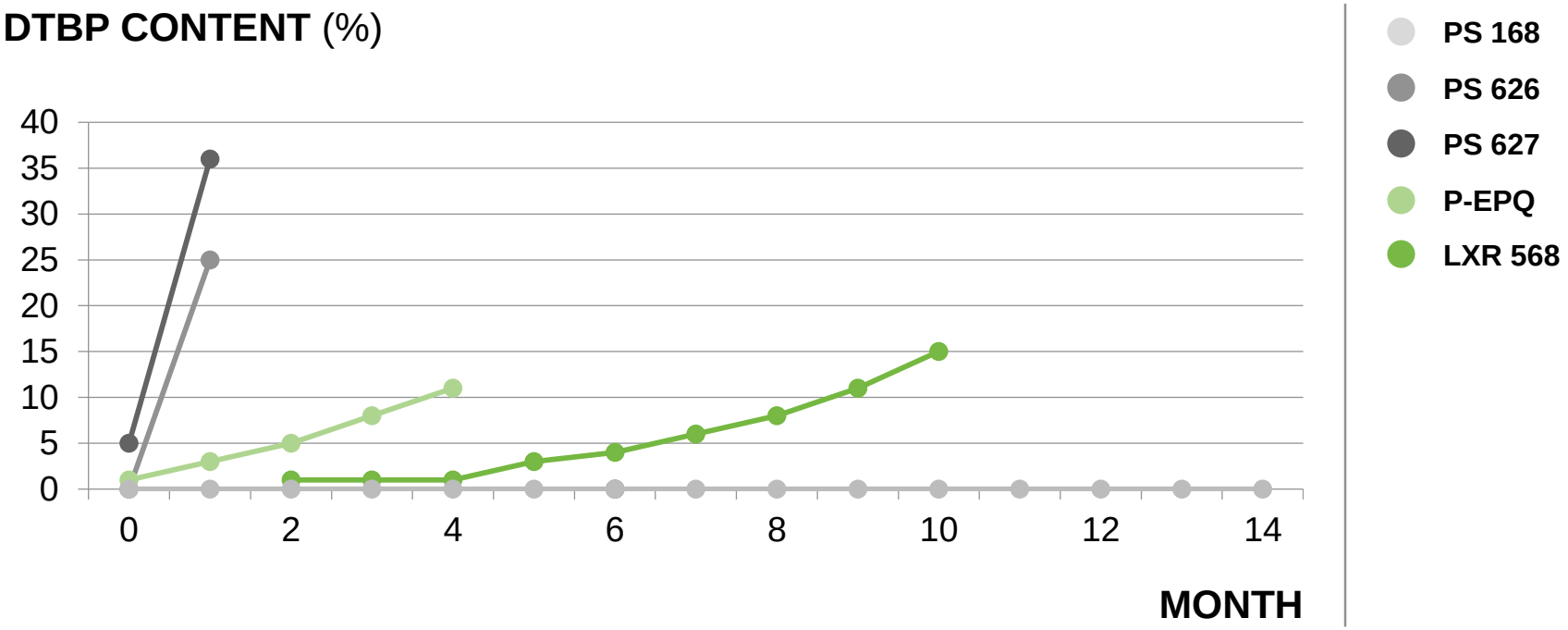
CLARIANT

Evaluation of hydrolytic stability

what is precious to you?

CLARIANT

Hydrolysis Stability in PE Zip Bag



Significant **higher hydrolytic stability** vs specialty phosphites. Easy to handle.
Formation of NIAS is retarded.

CLARIANT

Processing Stabilizer
Experiment – Hydrolytic stability test

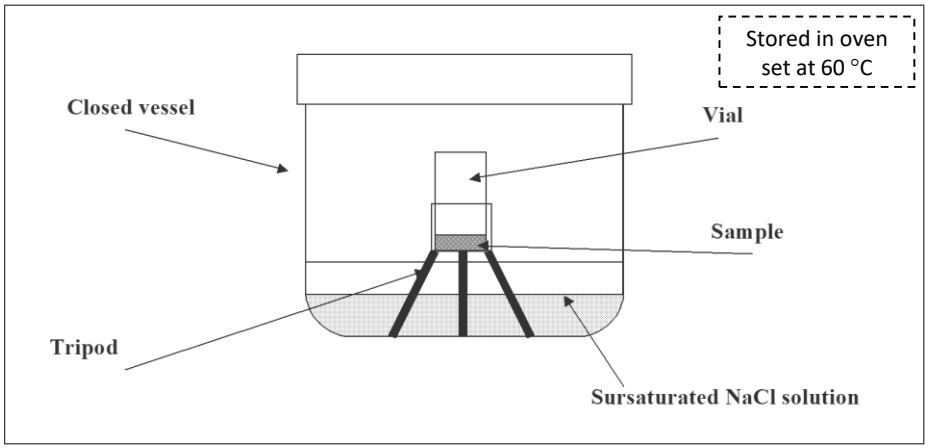
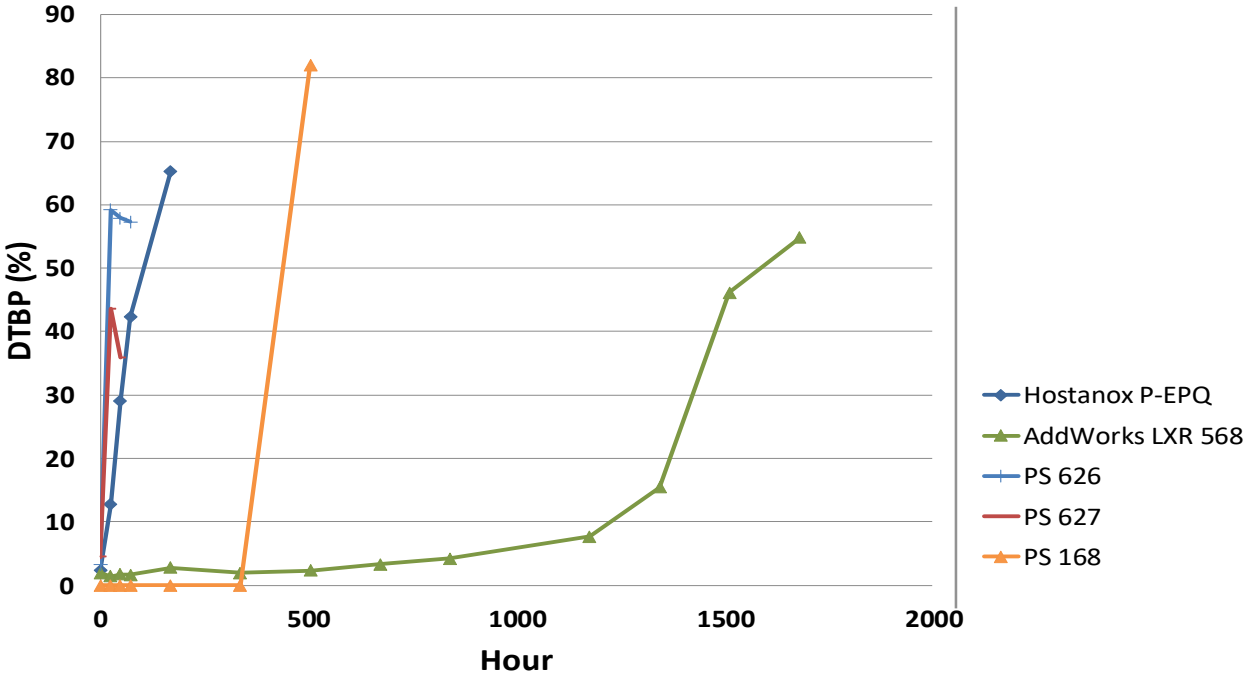


Figure: Hopper car testing system

The **Hopper car test** generates a saturated humidity atmosphere

CLARIANT

Hydrolysis stability in Hopper Car Test



- Significant **higher hydrolytic stability** vs specialty phosphites. Easy to handle.
- Formation of DTBP is deferred.

Evaluate comparative cleaning effect of Hostanox P-EPQ versus LXR 568 in LLDPE

CLARIANT

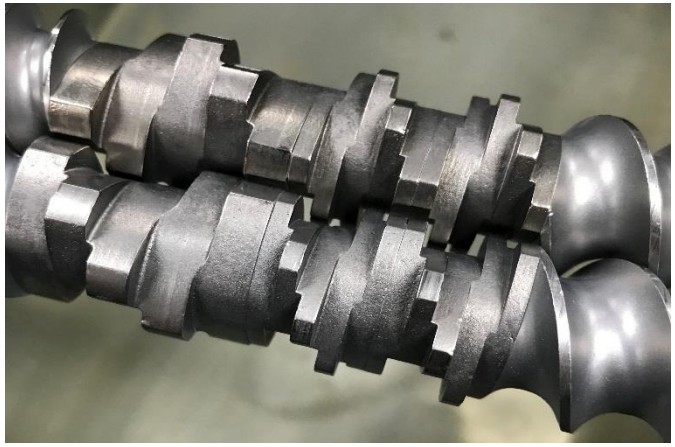
Confidential

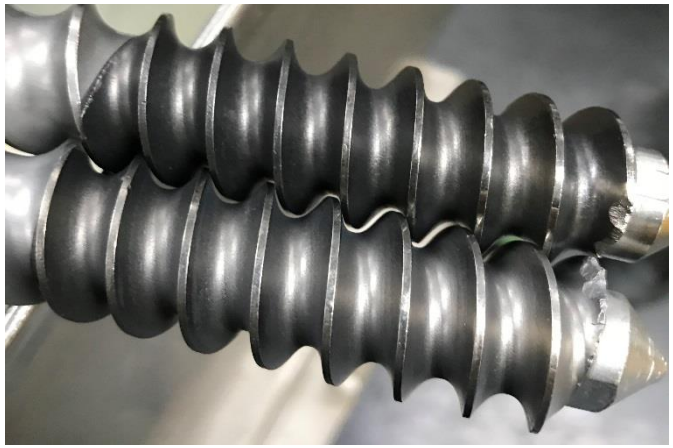
Dr. Hartmut Siebert, MSc
BU Additives
BL Performance Additives
17.01.2019

what is precious to you?

CLARIANT

Appearance of initial screw



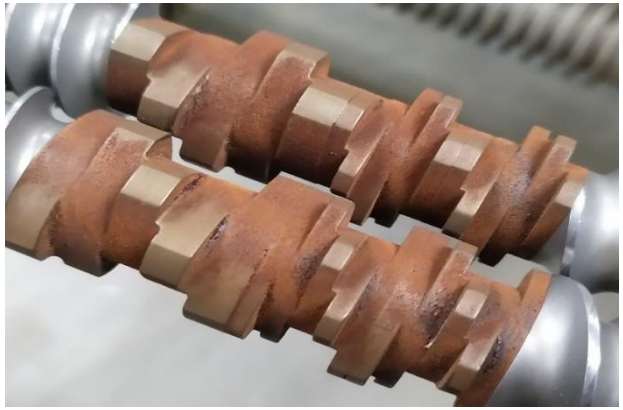


Blank initial screw

CLARIANT

Appearance of screw after MB production and after keep it under room temperature for 1 day

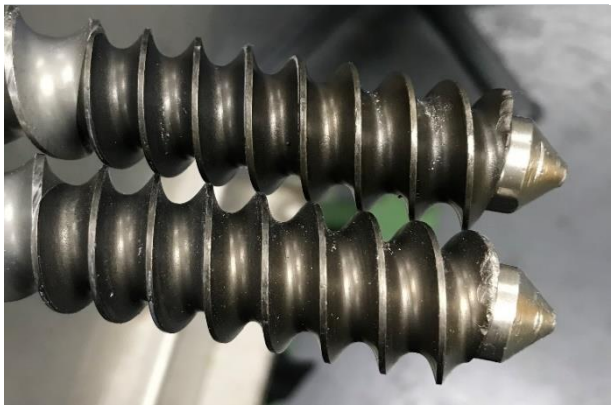
Immediate after MB production	After keep for 1 day



After production of LLDPE Masterbatch with 10% P-EPQ screw gets rusty

CLARIANT

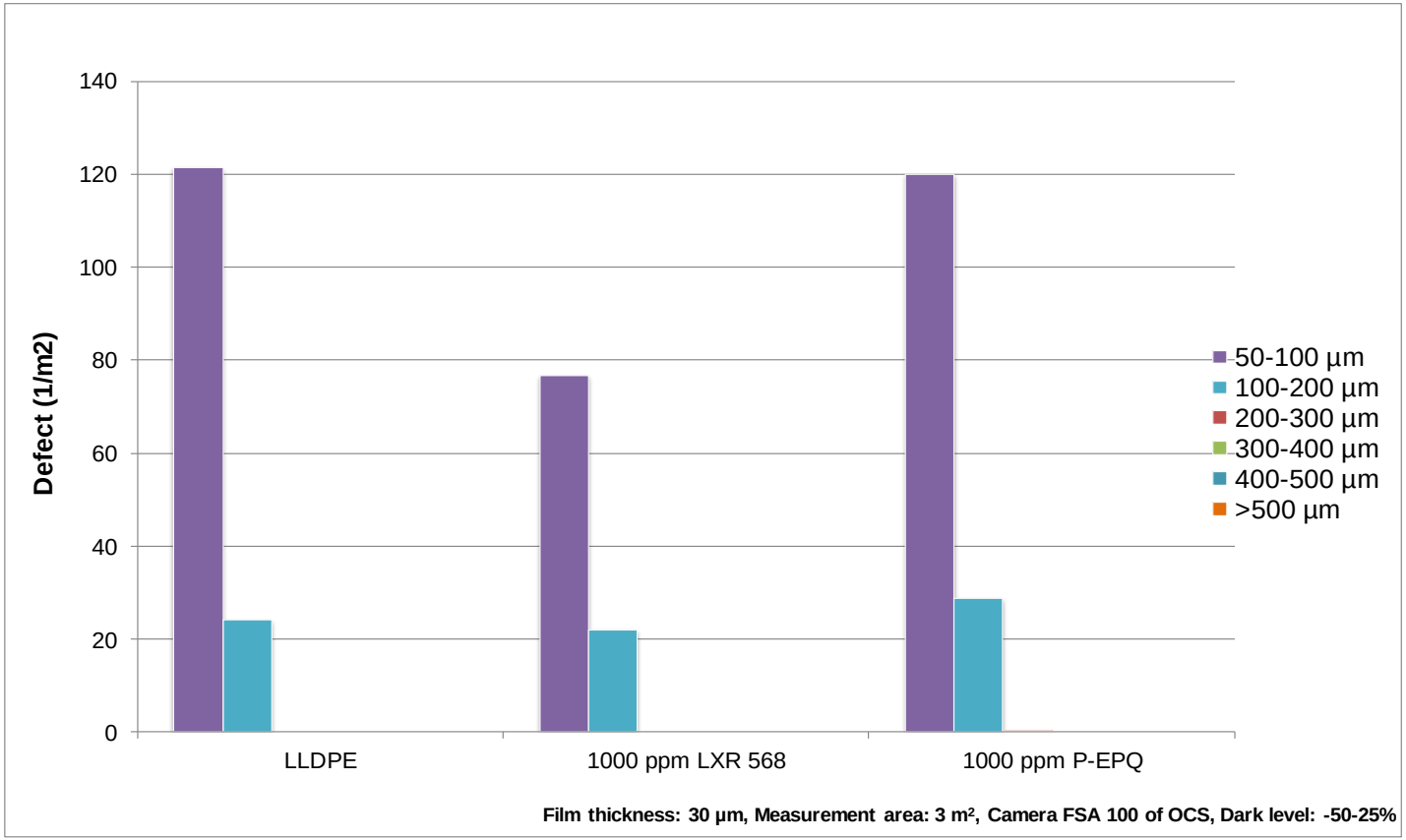
Appearance of screw after MB production and after keep it under room temperature for 1 day

Immediate after MB production	After keep for 1 day
	
	

After production of LLDPE Masterbatch with 10% AddWorks LXR 568, screw looks nice and clean

CLARIANT

Number of gels in LLDPE films with MB - Compounding process with rusty screw

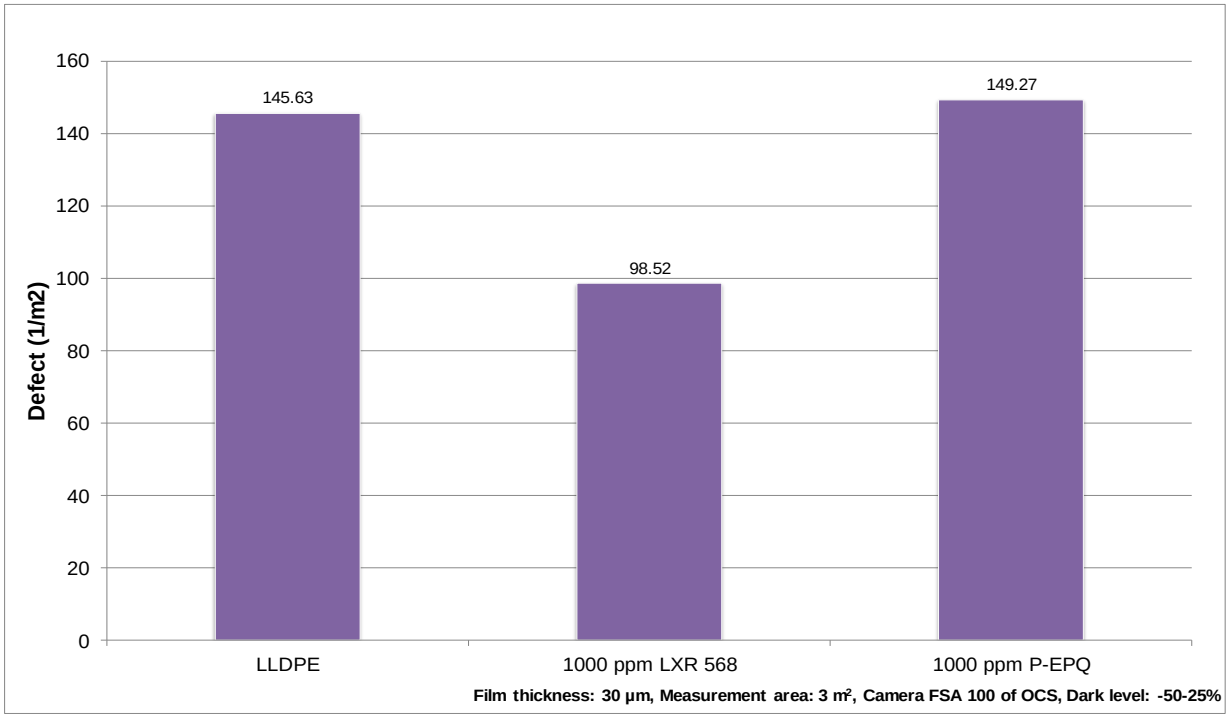


Note: Rusty screw and barrel was used to compound the formulations after purging screw by commercial LLDPE

Less gels with AddWorks LXR 568 compared to P-EPQ

CLARIANT

Number of total gels in LLDPE films with MB - Compounding process with rusty screw



Note: Rusty screw and barrel was used to compound the formulations after purging screw by commercial LLDPE

34 % less gels with AddWorks LXR 568 compared to P-EPQ

CLARIANT

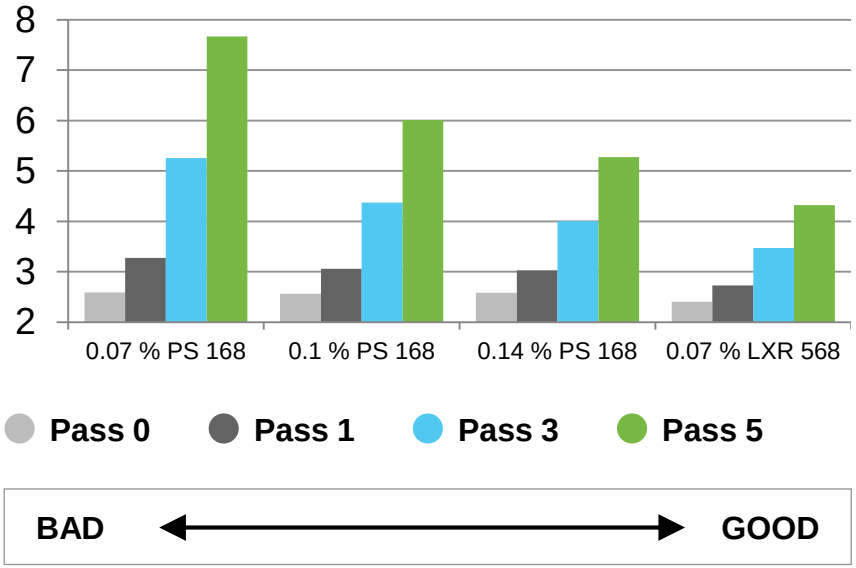
Adding Value to High Speed BOPP

what is precious to you?

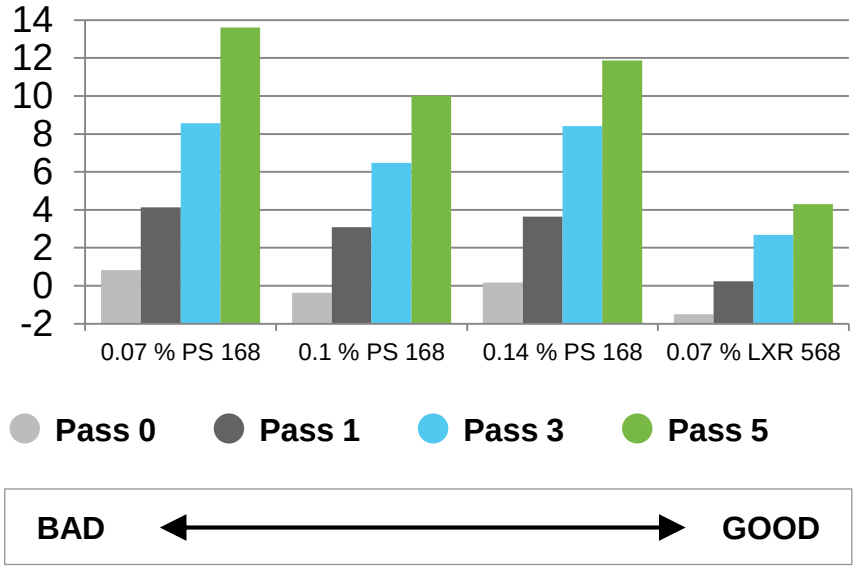
CLARIANT

High Processing stability for BOPP film grade

MFR 230 °C / 2.16 KG (G/10MN)



YELLOWNESS INDEX



Base Resin: BOPP, MFR = 2.0; **Base Stabilization:** 300 ppm Hycite 713 + 500 ppm AO 1010

44 % better MFR protection than PS 168
68 % better color protection than PS 168
No color improvement by increasing concentration of PS 168

Additive loading can be reduced by a factor of 2 to 3
Less plate out, less blooming, less die built-up

CLARIANT

Cost efficient solution for LLDPE processing

what is precious to you?

CLARIANT

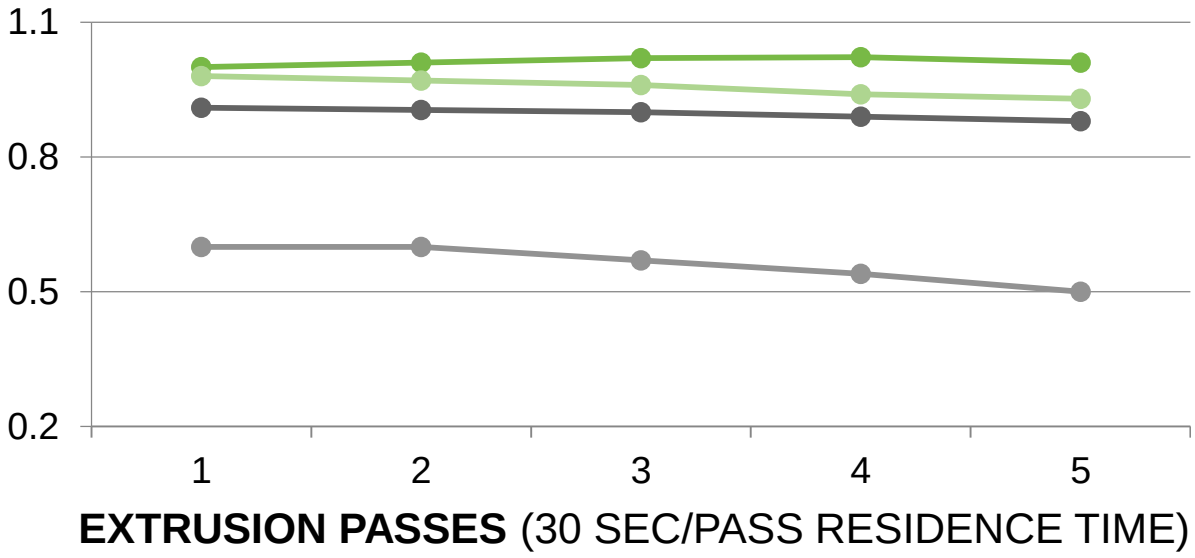
General requirements for film

- Melt and color stability
- High transparency
- Low gels
- Even film thickness profile

CLARIANT

Processing of LLDPE (0,918 g/cm³) at 240°C

MELT FLOW INDEX (MFI, 190°C/2,16 KG) [G/10MIN]



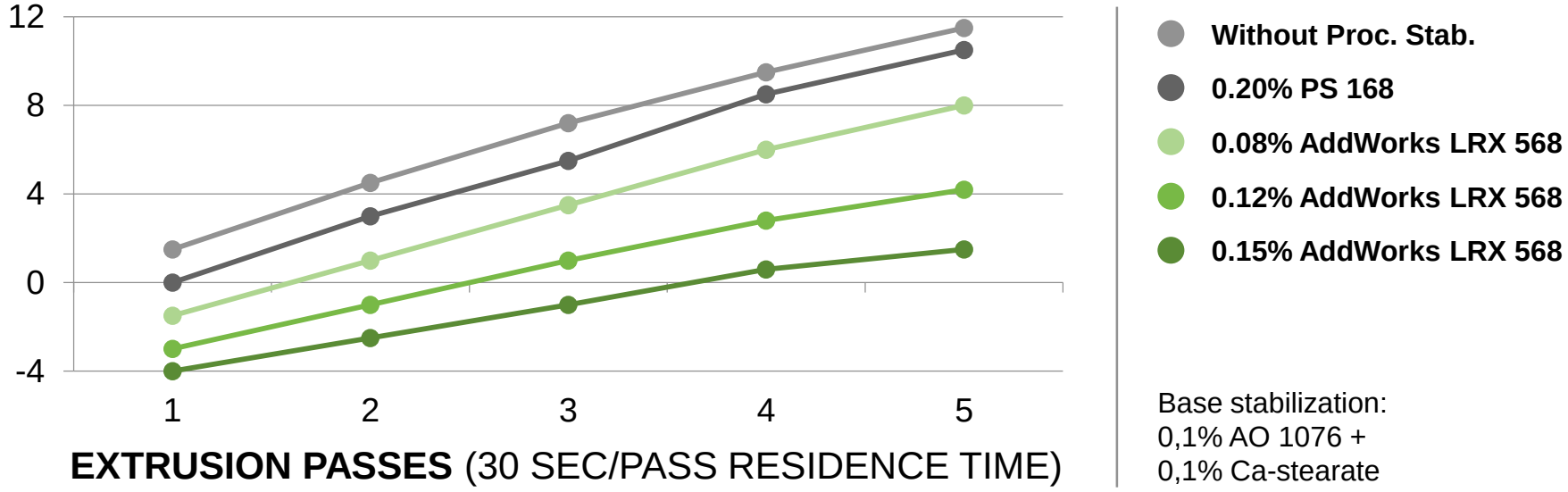
Base stabilization:
0,1% AO 1076 +
0,1% Ca-stearate

Superior **MFR retention of LLDPE** stabilized with solutions based on AddWorks LXR 568

CLARIANT

Processing of LLDPE (0,918 g/cm³) at 240°C

YELLOWNESS INDEX (PELLETS)



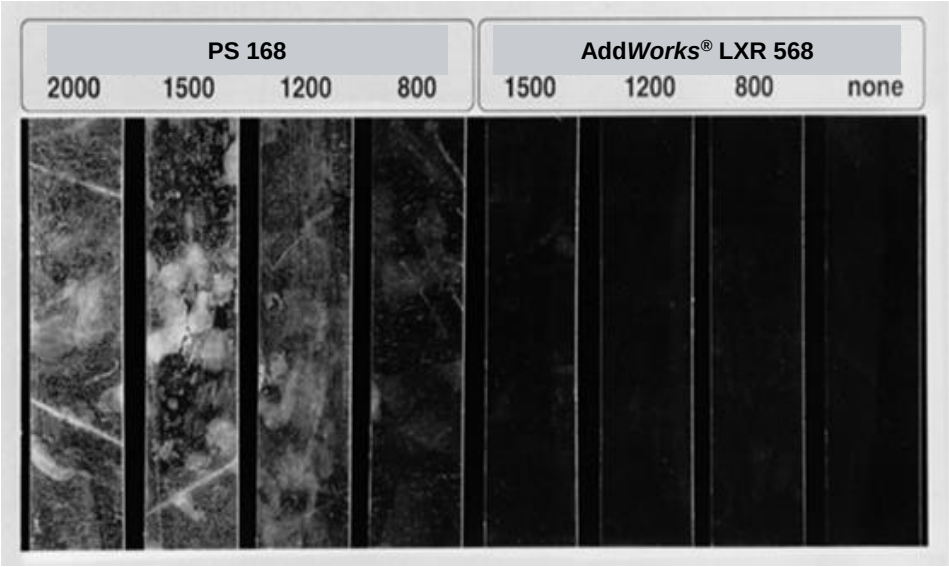
Base stabilization:
0,1% AO 1076 +
0,1% Ca-stearate

Outstanding **YI protection for LLDPE** stabilized with solutions based on AddWorks LXR 568

CLARIANT

Reduced blooming of LLDPE film

LLDPE FILM SAMPLES
(DENSITY = 0.917 G/CM3)
AFTER 1 YEAR STORAGE
AT 23 °C (73 °F)



Additive formulation:
200 ppm AO +
Processing Stabilizer

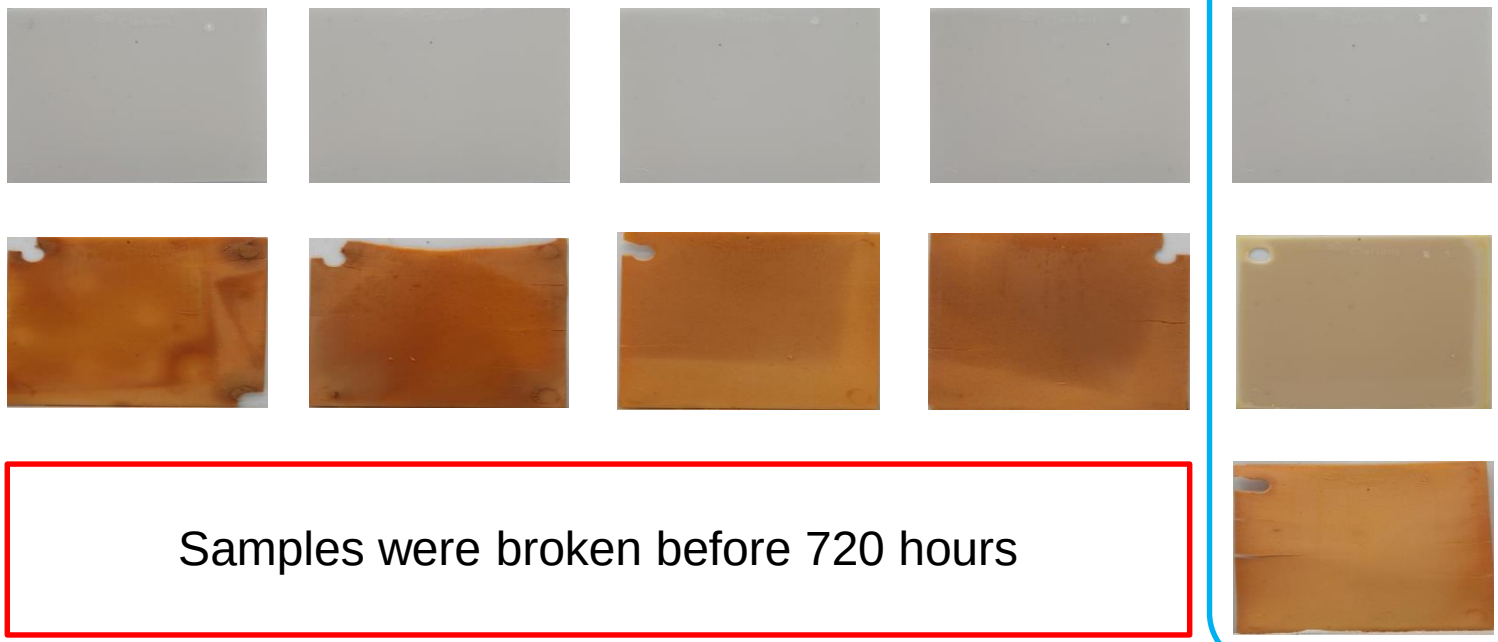
- **Excellent solubility** of AddWorks LXR 568 in LLDPE
- High **transparency** / **No blooming**
- **Nonyl-Phenol free** solution
- Especially suitable for **LLDPE cast film**, where a more enhanced stabilisation is needed

Long Term Heat Stabilization

what is precious to you?

CLARIANT

Oven ageing at 150°C
Surface Appearance of PP plates according PS class

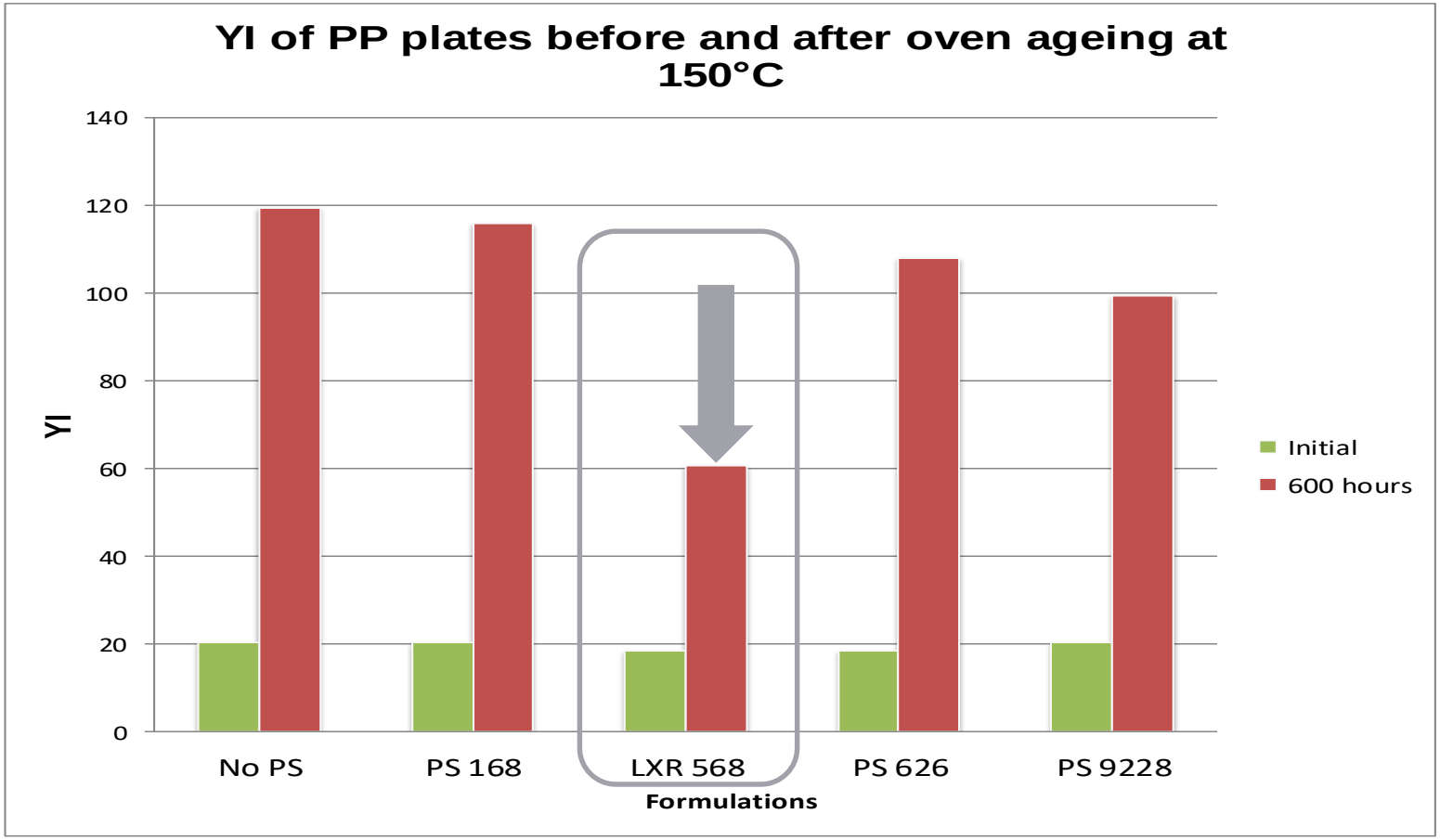


BS: PP + 0.1% AO 1010 + 0.1% PS + 0.2% Hostanox SE 4 (DSTDP) + 20% Talc

AddWorks LXR 568 allows better surface protection than other processing stabilizers

CLARIANT

Color retention of PP plates before and after oven ageing at 150°C

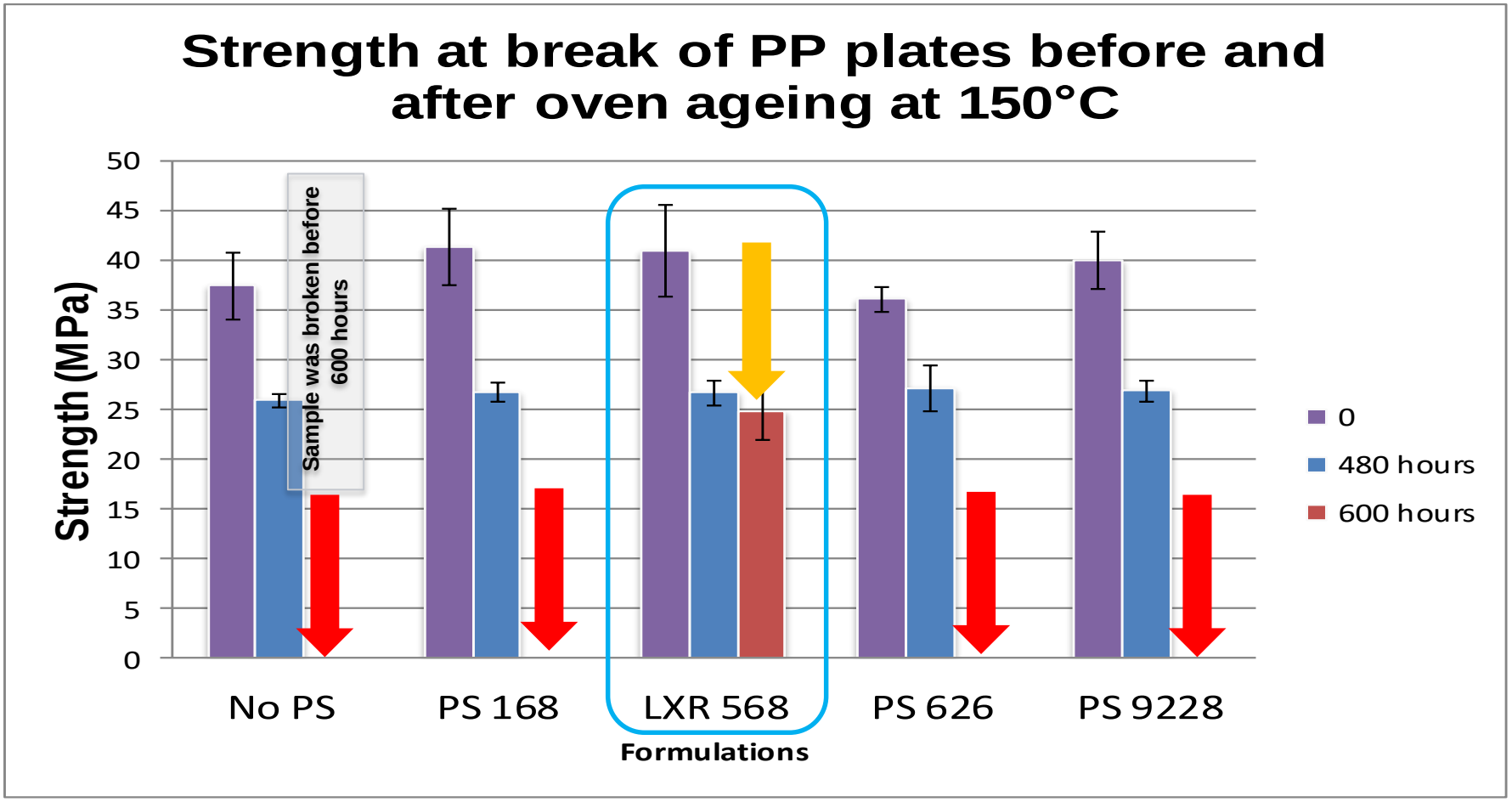


Formulation: PP + 0.1% PS + 0.1% AO 1010 + 0.2% Hostanox SE 4 + 20% Talc

AddWorks LXR 568 shows less yellowing compared to other processing stabilizers

CLARIANT

Mechanical properties retention at 150°C



Formulation: PP + 0.1% PS + 0.1% AO 1010 + 0.2% Hostanox SE 4 + 20% Talc

Only **AddWorks LXR 568** shows more than 50 % retention of strength at break after 600 hours

CLARIANT

Conclusion

- AddWorks LXR 568 shows superior performance on color stability and mechanical properties retention in PP compound vs most common processing stabilizers in long term heat stabilization of talc filled PP compounds.
- LXR 568 shows better appearance than PS 168, PS 626 and PS 9228 after oven ageing at 150°C reaching 600 hr.

Product Form

CLARIANT

Product Form

ADDWORKS LXR 568 MP

AddWorks LXR 568 is **available as free flow, dust-free micro pills**. It is easy to handle.

Key Benefits

CLARIANT

AddWorks LXR 568

- shows an outstanding colour stability and excellent MFR stability
- contributes to a superior oven ageing stability
- is easy to handle and is available as free flow, dust-free micro pills.
- shows a retarded formation of NIAS = non intentionally added substances
- does not hydrolyse upon exposure to moisture in the environment. It stays stable if packaging is accidentally left open or material is transported in hopper cars
- does not hydrolyse and cause black specks as do other phosphites and phosphonites
- can be fed better under humid conditions. It remains free flowing and full active, whilst other phosphites or phosphonites turn sticky and lose effectiveness.