Rhopoint ID Application Notes

CLARIFYING PLASTICS

Analysing the use of clarifying agents for obtaining transparent plastic parts

Overview

For many end-use products including food packaging, medical devices and transparent household and cosmetic containers, Polypropylene (PP) is a natural choice over many other materials due to its low cost, excellent mechanical properties and easy processing.

However, neat PP is translucent or opaque due to the particular semicrystalline arrangement of the polymer chains which presents an obstacle for its use in applications requiring maximal see-through quality. By using so-called 'clarifying agents' as additives, the optical transparency of PP and several other commodity polymers can be conveniently improved to, essentially, match that of glass or amorphous plastics, without compromising its superior mechanical properties.

The image shows two PP samples: one containing a clarifying agent (right) and the other in its neat, unblended form (left).

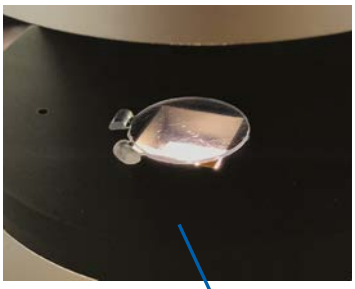
The image viewed through the sample features the highest contrast and sharpness of details.

The resulting transparent characteristics of PP are strongly dependent on a number of factors; most importantly: the specific clarifier used, its concentration and processing temperature. To ensure an optimal trade-off between the required transparency and cost increase via the use of expensive additives, haze and other transparency metrics are commonly measured during process development and production phases.

Rhopoint ID enables this analysis with an unprecedented level of detail and precision.

OTHER APPLICATION NOTES:
- Surface roughness and bulk scatter
- Taber abrasion
- PET bottles
- Distance haze
- Blister packaging

PROCESS Example-PP samples with varying clarifier content

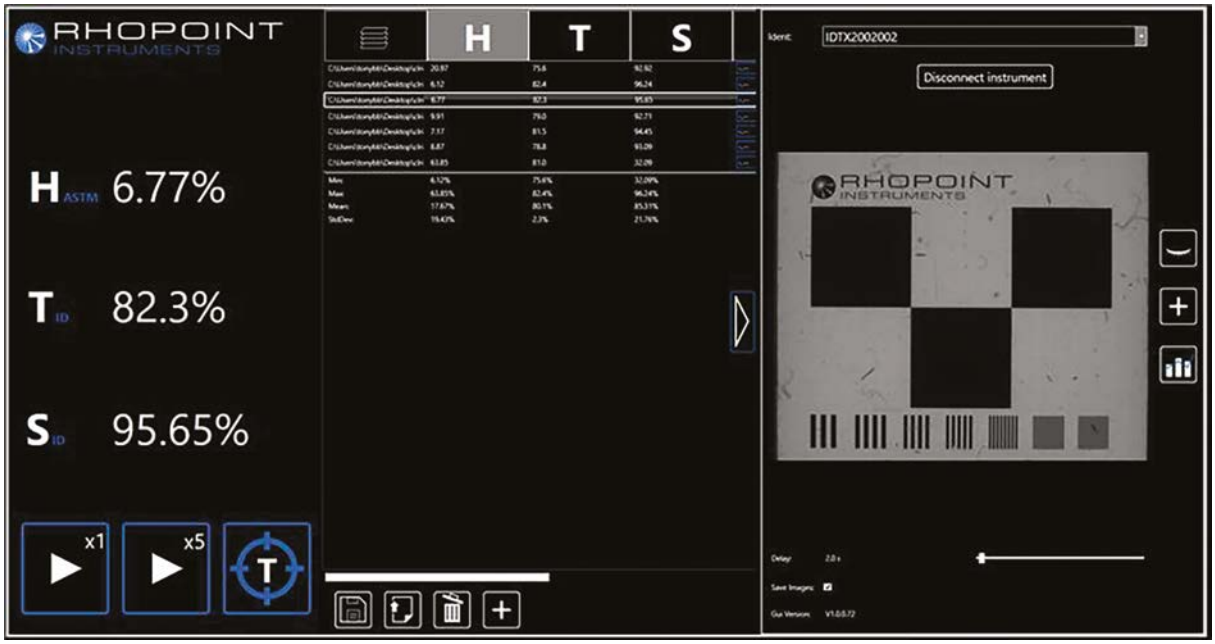


STEP 1: The samples are mounted directly onto the ASTM spacer adaptor on the measurement **GRATICULE**.

Ten injection-molded PP plaques were used to analyse the effect of a varying content of a sorbitol-based clarifying agent on the resulting transparency. Each sample was individually tested using Rhopoint ID-L to provide the respective values of Haze (H_{ID}), Sharpness (S) and Visible Transmittance (VT).

Reference measurements of ASTM Haze (H_{ASTM}) were performed using a sphere-based ASTM D1003 haze-meter.

STEP 2: Rhopoint ID-L software allows to observe and quantify the changes in optical transparency.



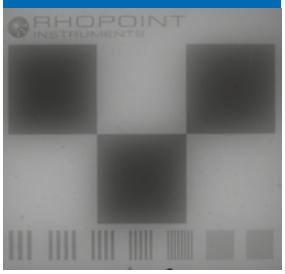
STEP 3: Images and data are collected for all samples.

RESULTS Example – PP samples with varying clarifier content

Exemplary images and data for two PP plaques: neat and optimally clarified

Key:
H_{ID}=Haze (ID) **S**=Sharpness **VT**=Visible transmission **H_{ASTM}**=Haze (ASTM)

NEAT UNCLARIFED PP

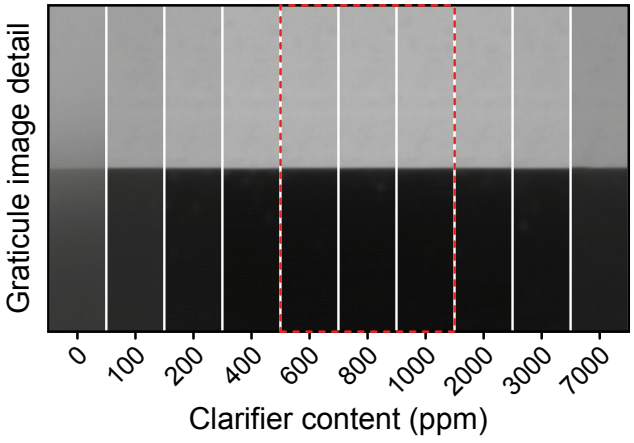


H_{ID}:	64.0
S:	35.3
VT:	81.5
H_{ASTM}:	69.1

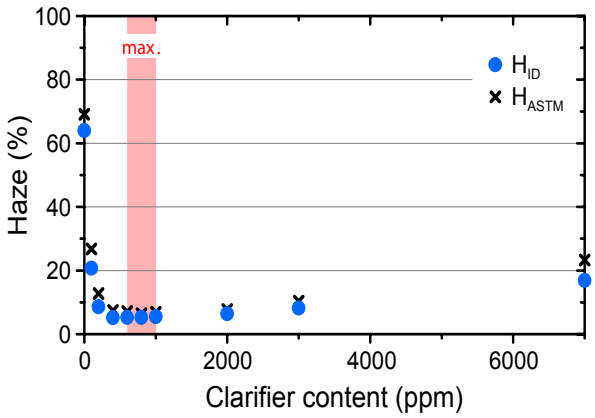
PP+CLARIFIER (800PPM)

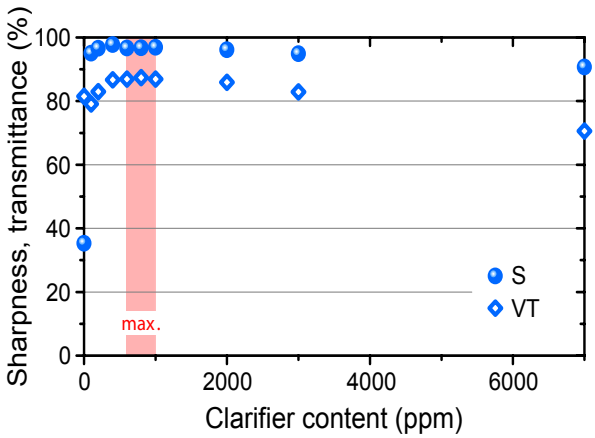
H_{ID}:	5.3
S:	96.8
VT:	87.4
H_{ASTM}:	6.4

Data below shows zoomed-in views of the graticule, haze (ID and ASTM), sharpness and visible transmittance for PP samples with varying clarifier content. The sample range featuring exhibiting maximal transparency is highlighted.



Sharpness and Haze(%) *vs* Clarifier (ppm)





Maximum transparency (i.e. lowest haze and highest sharpness and visible transmittance) is observed for a narrow, 600–1000 ppm concentration range of the clarifier, as shown by the highlighted data regions.

A close correspondence is found for the ID- and ASTM haze data.

Comparison of data and graticule images confirms that the quantitative analysis correlates closely with the visual perception of transparency.

RESULTS-Advanced transparency analysis content

In addition to the measurements above, Rhopoint ID-L can provide a more sophisitcated analysis of transparency that is outside the capabilities of sphere-based haze meters.

Identification and elimination of local defects

This includes common defects such as dust, scratches and processing imperfections. By virtue of being an imaging-based technique, data can be obtained for the entire graticule or its individual regions to provide spatially-averaged or local values.

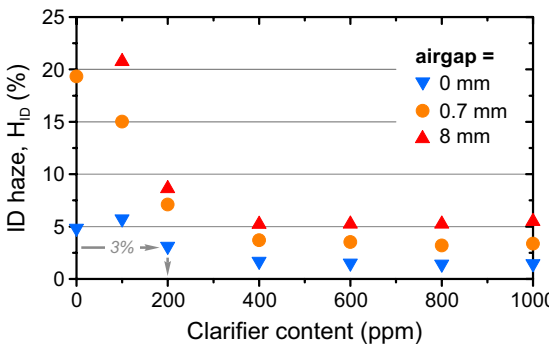
Analysis of airgap-specific transparency

Can be used to determine optimal, application-specific material formulations and processing conditions, as well as establish transparency benchmarking.

The example below shows haze for clarified PP at different 'airgap' distances.

If the material is intended to be used in contact for packaging applications and an upper limit of haze = 3% is required then the analysis determines the optimal clarifier content of 200 ppm.

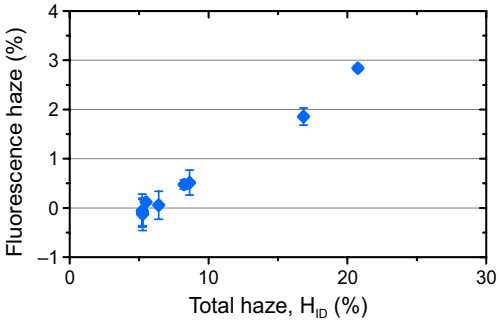
In comparison, sphere-based haze-meter measurements provide an airgap-idependent optimal value of 800 ppm. Hence, Rhopoint ID-L enables substantial cost savings by allowing to minimise the use of expensive additives.



Analysis of fluorescence impact on transparency

Can be used in the case of whiteners and fluorophores employed as additives in, e.g. packaging and cosmetics industry sectors.

The example below shows haze values measured with white and filtered light.



Here it is shown that the particular whitener used in the commercial clarifying agent contributes an appreciable fraction of 'fluorescence haze' to the total haze.

Hence, Rhopoint ID-L allows to optimise material formulations for application-specific lighting and viewing conditions.

Fluorescence haze vs total haze for PP samples with varying clarifier content.

Further details and examples can be found in the article in **Macromolecular Materials & Engineering.**

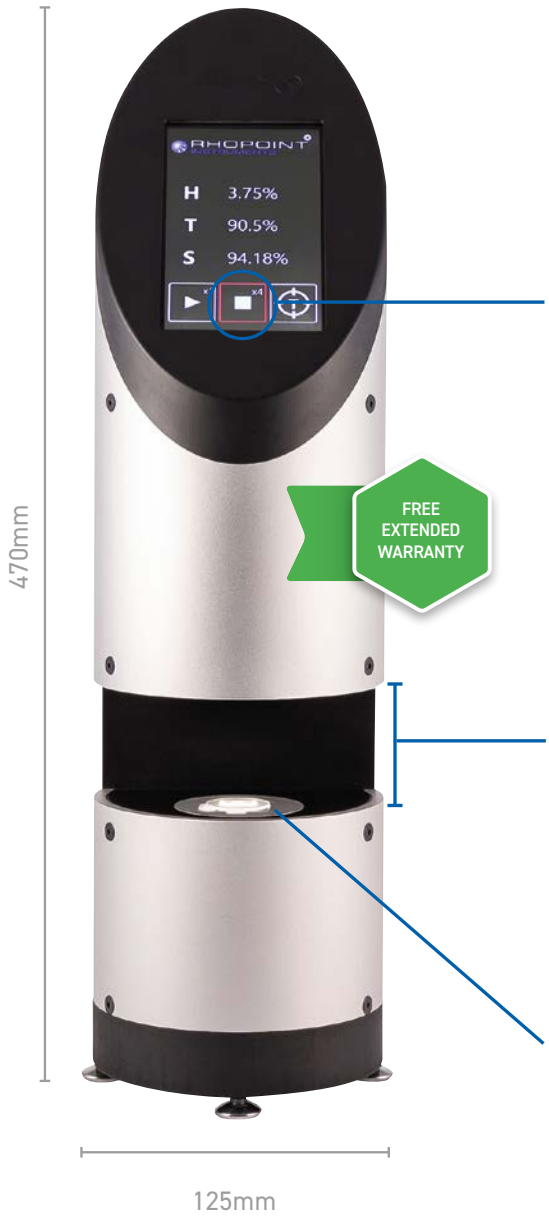
Features of the Rhopoint ID

No moving parts
Eliminates risk of mechanical failure

Stand-alone instrument
Small footprint reduces space required in laboratory

Lightweight
Easy to move in the laboratory or production line

Resistant and durable
Made from durable, recyclable materials



Touch screen
Single measurement time of 2 seconds to measure ALL parameters (up to 15 seconds on a comparable sphere instrument)

Large mounting area
Minimal sample preparation required possible to measure non flat samples without bending or deforming.

Fully sealed optics
Ideal for measuring liquid samples and solid materials impervious to damage through accidental spillage

KEY FEATURES
✓ Measurement of Haze, Transmission and Optical Sharpness in one fast measurement
✓ Captured images provide confirmation of change in Optical characteristics during dosing
✓ Increased sensitivity of image-based measurement compared to ASTM sphere based method
✓ Rhopoint ID-L software allows comparison of sample data and images
✓ Sample movement between measurement ports not required
✓ Permits changes to be determined quickly and effectively during formulation or in-process
✓ Faster more discriminative measurement providing higher accuracy and sensitivity
✓ Easily compare multiple sample measurements on screen

FULL PRODUCT DETAILS

VIEW DATA SHEET

TRY BEFORE YOU BUY

We offer two options for you to try out the Rhopoint ID before buying.

1. **Online demonstration:** Online presentation of the Rhopoint ID with your samples measured LIVE on Zoom, TEAMS or Skype. Includes consultation with an application specialist.

2. **Factory sample testing:** Send in samples of your material for testing and receive a comprehensive test report.

Arrange a demo

Ready to receive a quote? **Click here**

Rhopoint Instruments Ltd
Rhopoint House, Enviro 21 Park, Queensway Ave S,
St Leonards, TN38 9AG, UK

T: +44 (0)1424 739 622
E: sales@rhopointinstruments.com
www.rhopointinstruments.com

Rhopoint Americas Inc.
1000 John R Road, Suite 209, Troy,
MI, 48083, United States

T: 1.248.850.7171
E: sales@rhopointamericas.com
www.rhopointamericas.com

Rhopoint Instruments GmbH
An der Kanzel 2
D-97253 Gaukönigshofen, Deutschland

T: +49 (0)9337 900-4799
E: info@rhopointinstruments.de
www.rhopointinstruments.de

bsi ISO 9001 Quality Management Systems CERTIFIED
FS 695373

All images are for illustrative purposes only