


# test results Liquisol 4ever



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Bericht – Nr.: PH001/10	Gruppe Physik	<i>Seite 1 von 6</i>

## Test report

**Client:** Liquisol  
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BELGIUM

**Order No.:**

**Subject of testing:** 3 panels  
- A: PMMA glass without coating  
- B: PMMA glass with „Liquisol 4ever“ single layer coating  
- B: PMMA glass with „Liquisol 4ever“ double layer coating

We received the samples on Monday, 8<sup>th</sup> January 2010

**Objective of testing:** Measurement of transmission and reflection  
Calculation of TSR, TSA, TST and VLT using solar irradiance data according ASTM G173-03 “Reference Spectra Derived from SMARTS v. 2.9.2”

**Start of tests:** 11.02.2010

**End of tests:** 03.03.2010

**Prüfmethode** UV-VIS-NIR- Spectrometer Lambda 900 (Perkin Elmer)  
Spectral range: 250 to 2200 nm  
Data interval: 1 nm  
Slit 3 nm  
Calibration (base line): 0% and 100% reflection (white standard)

## Samples

The received samples are coated quite inhomogenously. Fig. 1 shows a photograph of the samples placed on black paper.

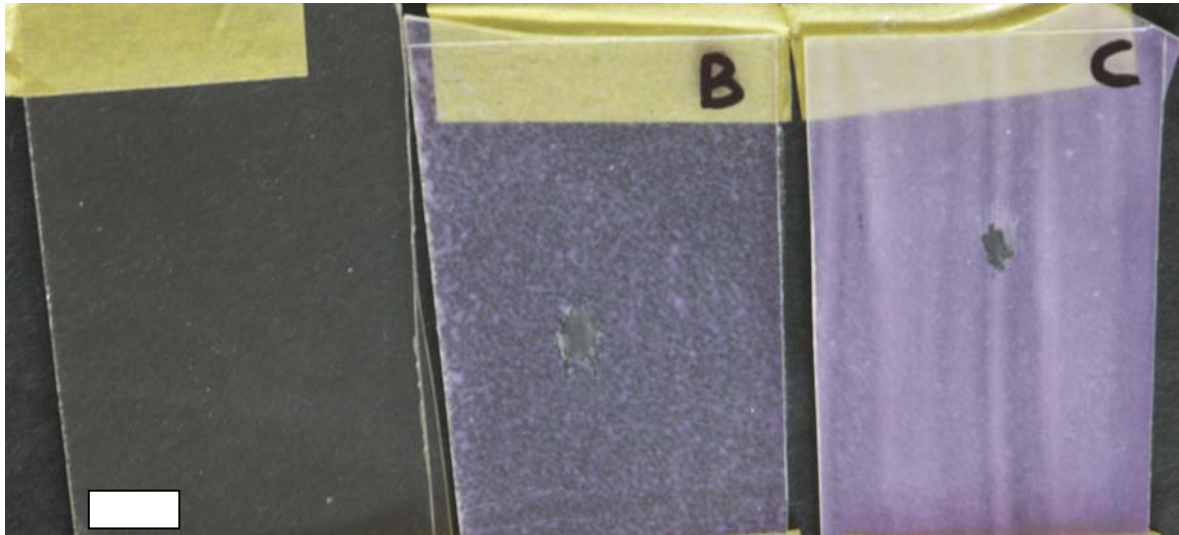


Fig. 1: Photograph of the samples placed on a black paper  
white area: measurement area in reflection  
scratched area used for thickness measurement

The area covered by the measurement is about  $4 \times 11 \text{ mm}^2$  in transmission and  $5 \times 12 \text{ mm}^2$  in reflection, therefore a statistically relevant area is covered by the measurements.

Sample thickness was measured by scratching away the coating and measuring the step height with a profilometer.

Sample B (1 layer) was  $14 \pm 1 \text{ }\mu\text{m}$  thick, sample C (2 layer)  $23 \pm 2 \text{ }\mu\text{m}$ .

## Reflectance and Transmittance Spectra

Reflectance and Transmittance Spectra are shown in Fig. 2 and 3. The coated side was directed towards the incident beam.

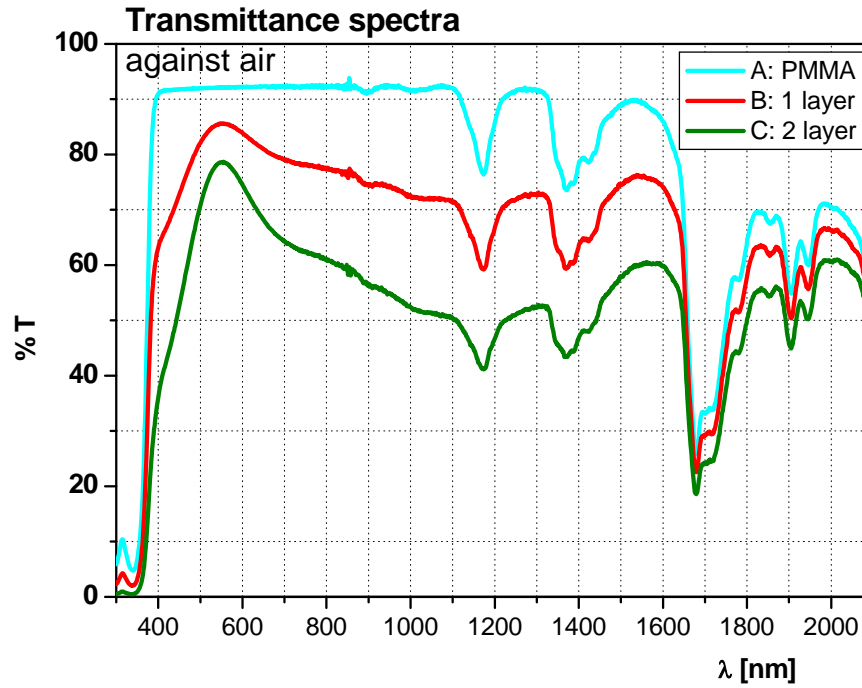


Fig. 2: Transmittance spectra against air

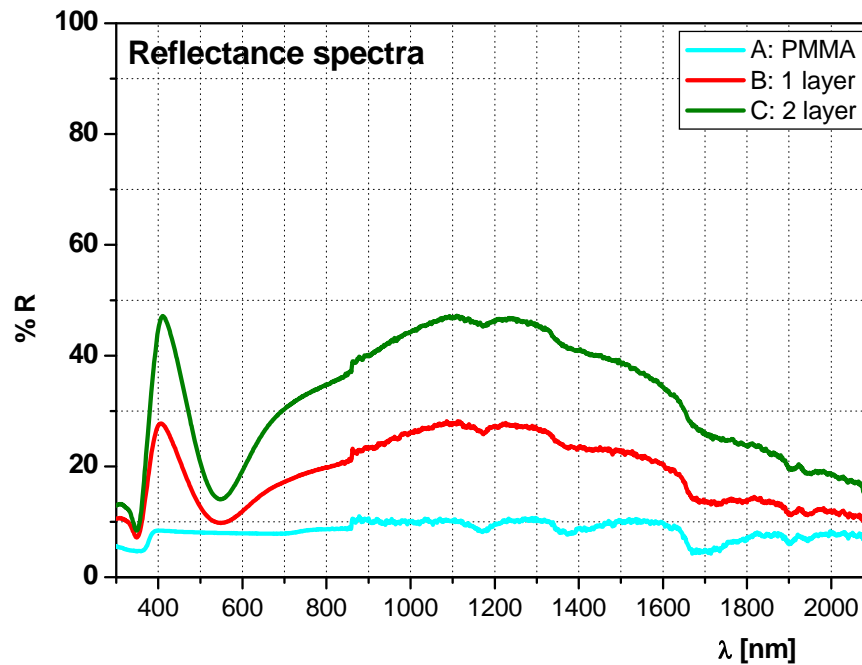


Fig. 3: Reflectance spectra

## Calculations

Multiplying the solar irradiance data from “ASTM G173-03 Reference Spectra Derived from SMARTS v. 2.9.2” (Direct+circumsolar) with the measured transmittance (against air) and reflectance spectra, power spectra of the reflected and transmitted radiation can be calculated (Fig. 4 and 5). These spectra were integrated in the full range (300 to 2100 nm) and in the visible light region (380 to 780 nm, shown by the blue dashed lines). Results are listed in table 1 and plotted in Fig. 6.

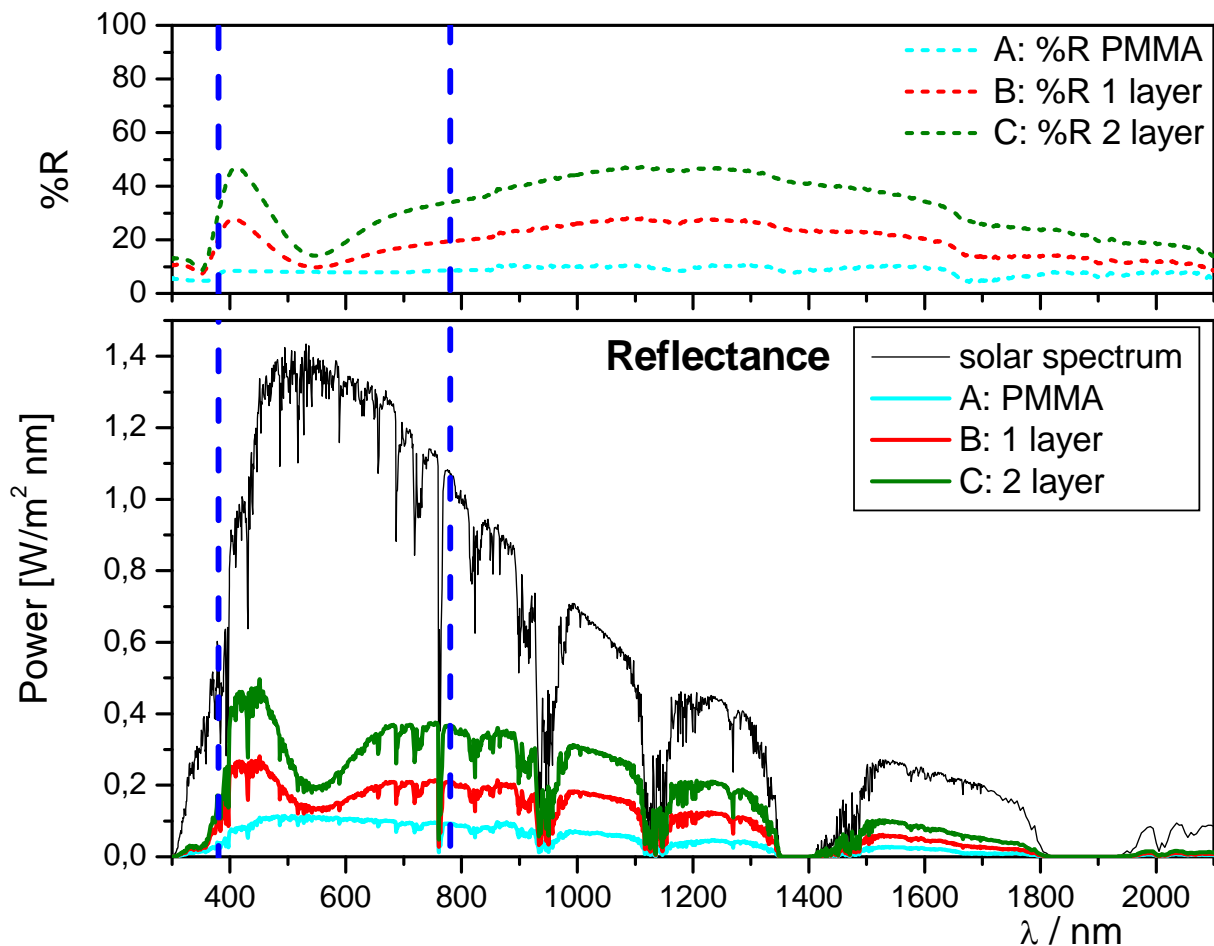


Fig. 4: Power spectrum of reflected radiation

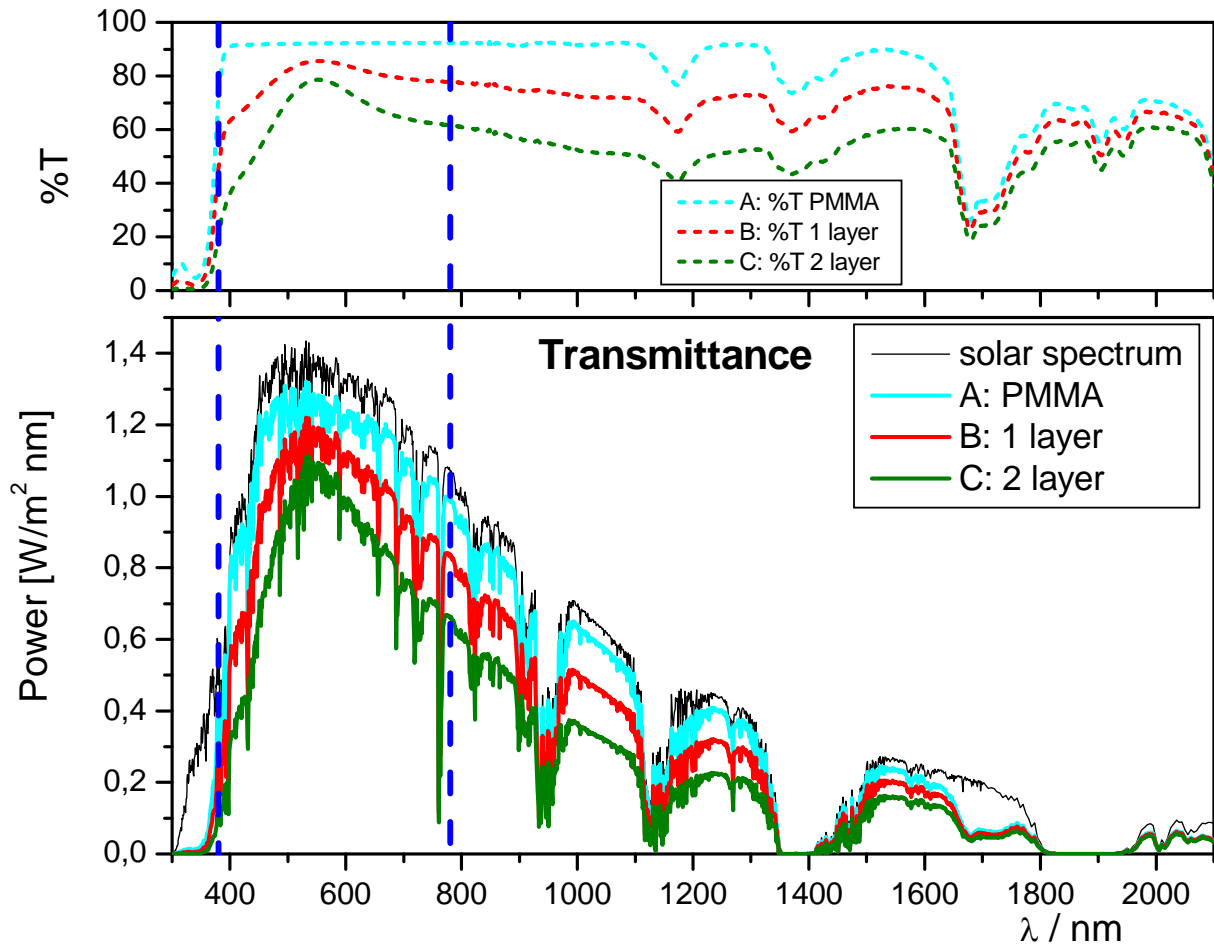


Fig. 5: Power spectrum of transmitted radiation

Table 1: TST, TSR, TSA and VLT

	Trans	Refl	Abs		Trans	Refl	Abs
	[W / m <sup>2</sup> ]				[%]		
total spectrum (300 to 2100 nm)				respect. solar: 870 W/m <sup>2</sup>			
PMMA	765	75	30	88,0%	8,6%	3,4%	
1 layer	643	165	62	73,9%	18,9%	7,2%	
2 layer	511	279	79	58,8%	32,1%	9,1%	
vis. spectrum (380 to 780 nm)				respect. solar: 467,8 W/m <sup>2</sup>			
PMMA	430,3	37,8	-0,2	92,0%	8,1%	0,0%	
1 layer	371,2	74,0	22,6	79,3%	15,8%	4,8%	
2 layer	307,1	124,8	36,0	65,6%	26,7%	7,7%	

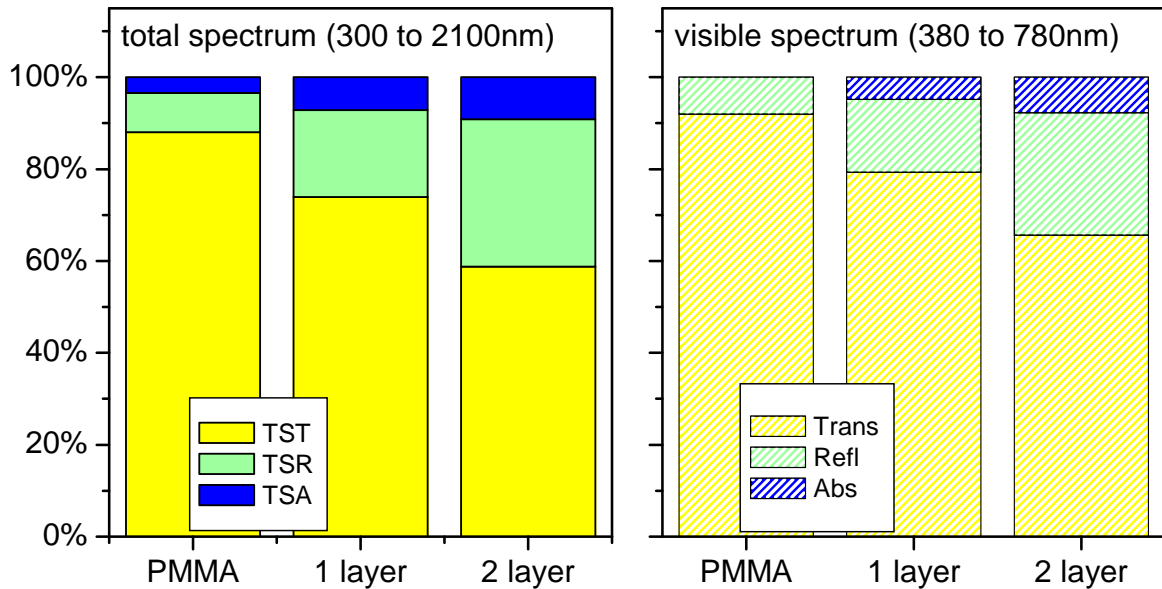


Fig. 6: Reflected, absorbed and transmitted part in percent of the radiation of the whole spectrum (300 to 2100 nm) and in the visual range (380 to 780 nm)

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Stuttgart, 03.03.2010

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