3M™ Glass Bubbles

Applications in Paints and Coatings

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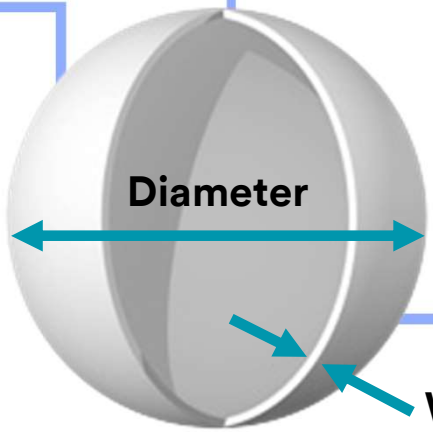
Make it all-round – 3M™ Glass Bubbles

Hollow

Lightweight

Thermally insulating

White



Spherical

Low oil absorption

Lower viscosity

Lower shrinkage

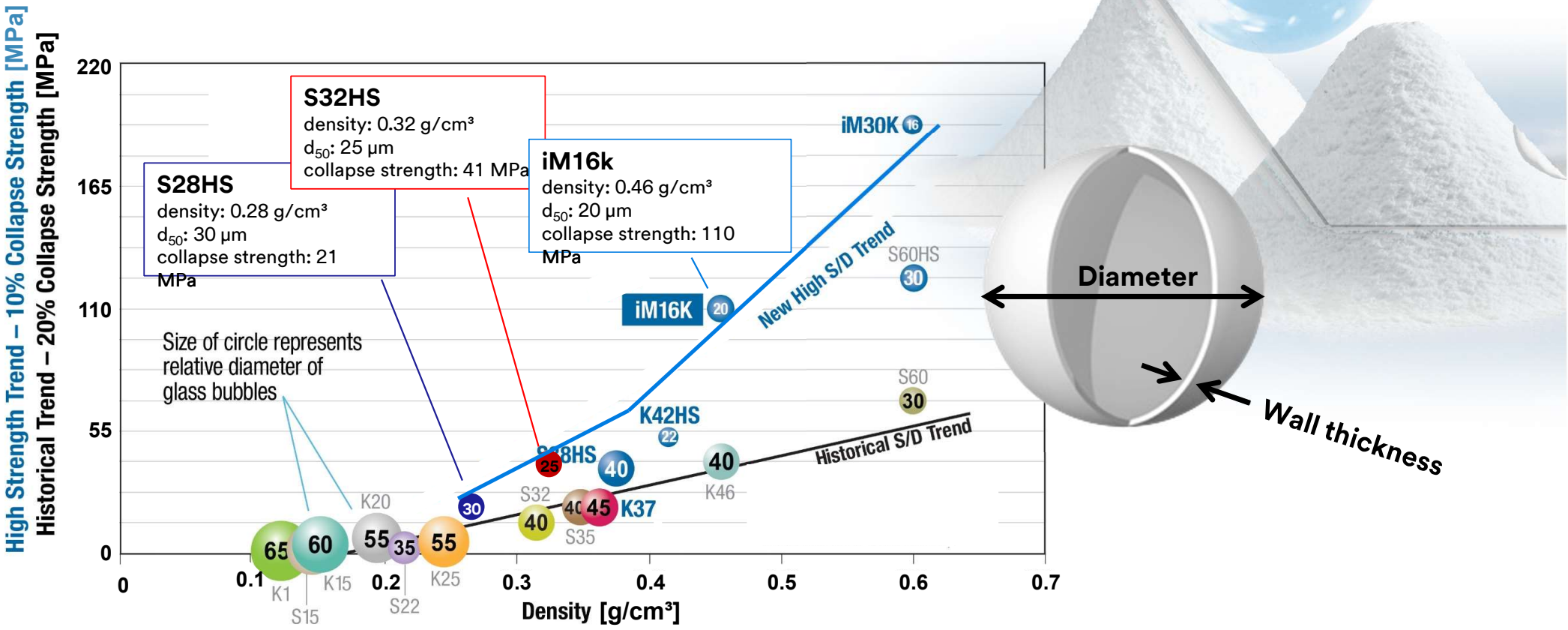
Glass

Inorganic

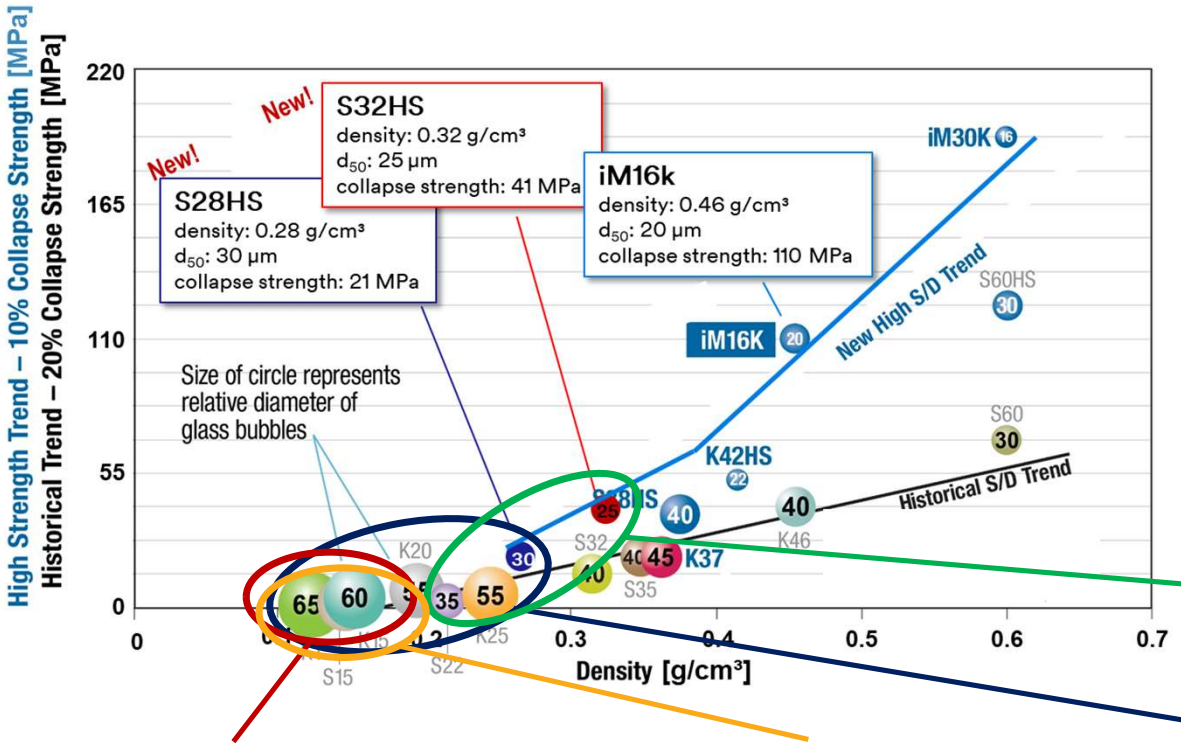
Non-porous

Water insoluble

3M™ Glass Bubbles - Portfolio Overview



3M™ Glass Bubbles in Paints & Coatings

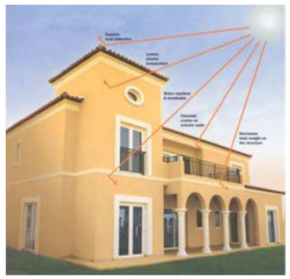


Thermal insulation paints & plaster

Tile adhesives

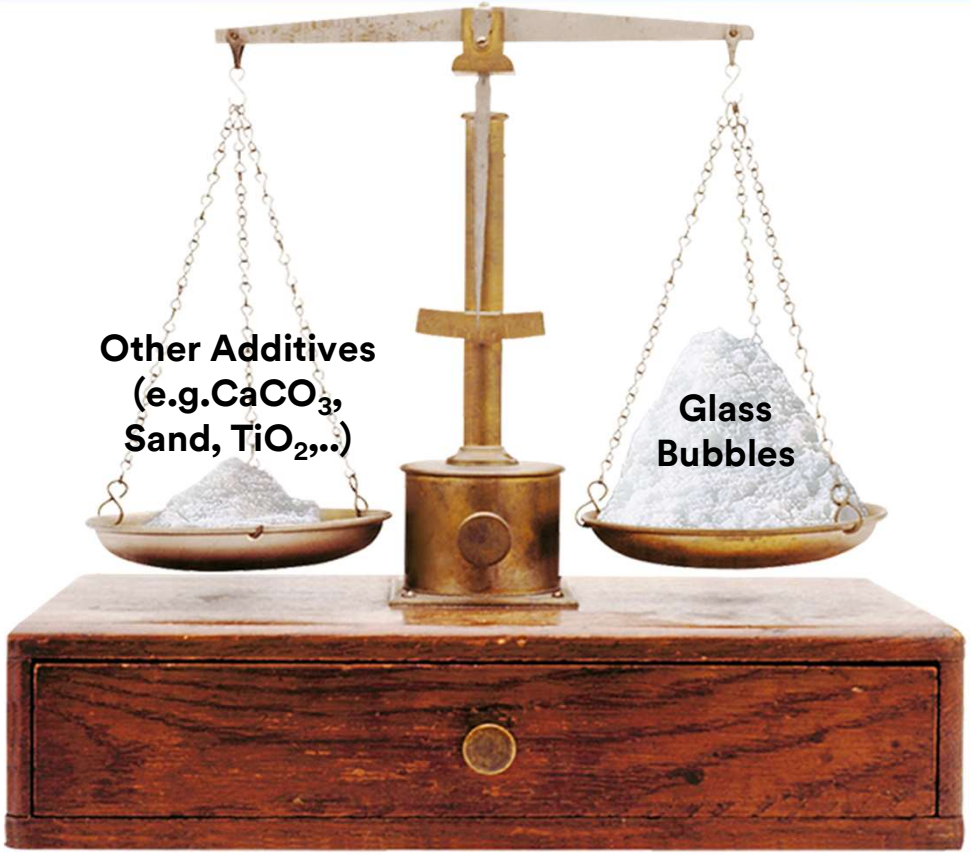
Spackle; Wall fillers

Solar heat reflective paints

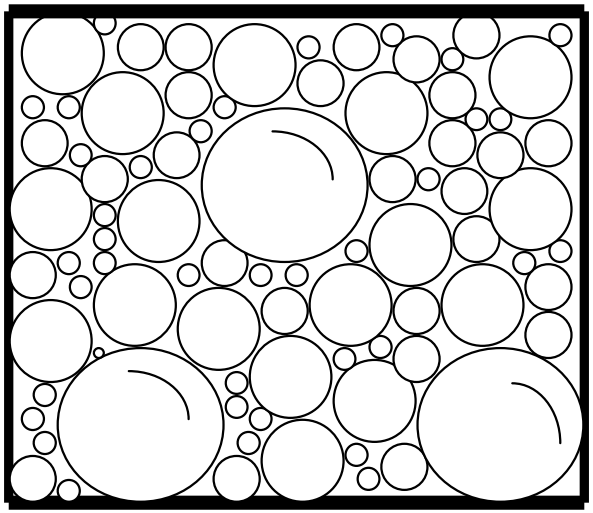


Formulating with 3M™ Glass Bubbles

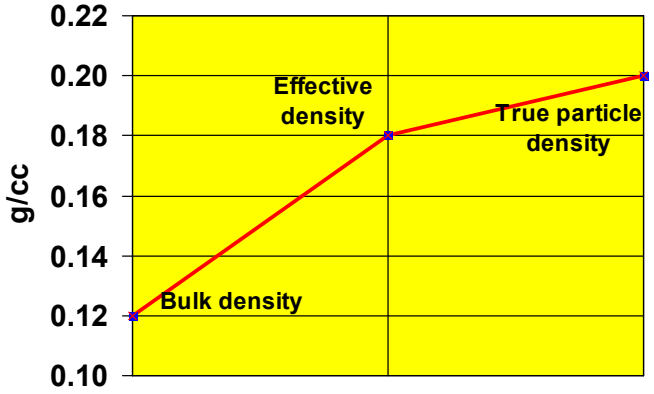
Always think in terms of volume loading



3M™ Glass Bubbles – Definition of Density



Glass Bubbles K20



- Bulk density

  Ratio of Glass Bubble weight to full container volume, included air-filled spaces

- Effective density

  Ratio of Glass Bubble weight to bubble volume including certain amount of trapped air when mixed in a liquid (also called “liquid displacement”)

- **True particle density**

  Ratio of Glass Bubble weight to true particle volume when Glass Bubbles are fully surrounded by a gas *(measured with a gas pycnometer)*.

Specification for Glass Bubbles is true particle density!

3M™ Glass Bubbles

Hollow Glass Microspheres

Applications in Interior Paints

3M™ Glass Bubbles in Paints

Anti-Condensation Paint

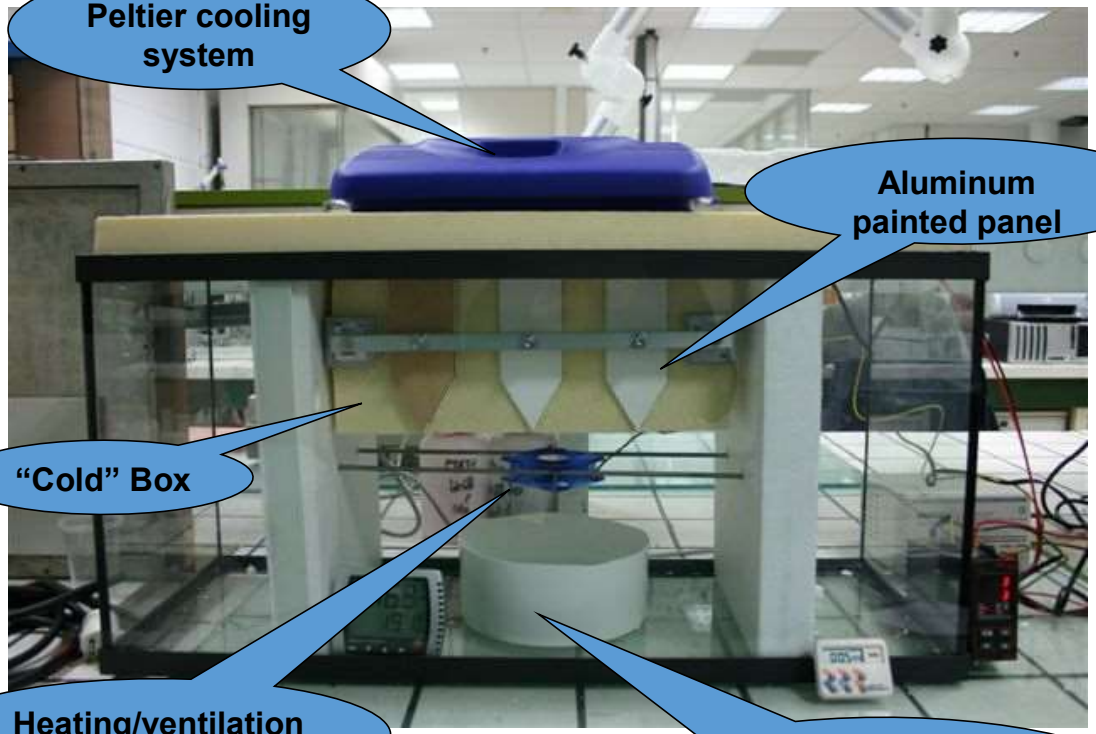
Advantages/Benefits:

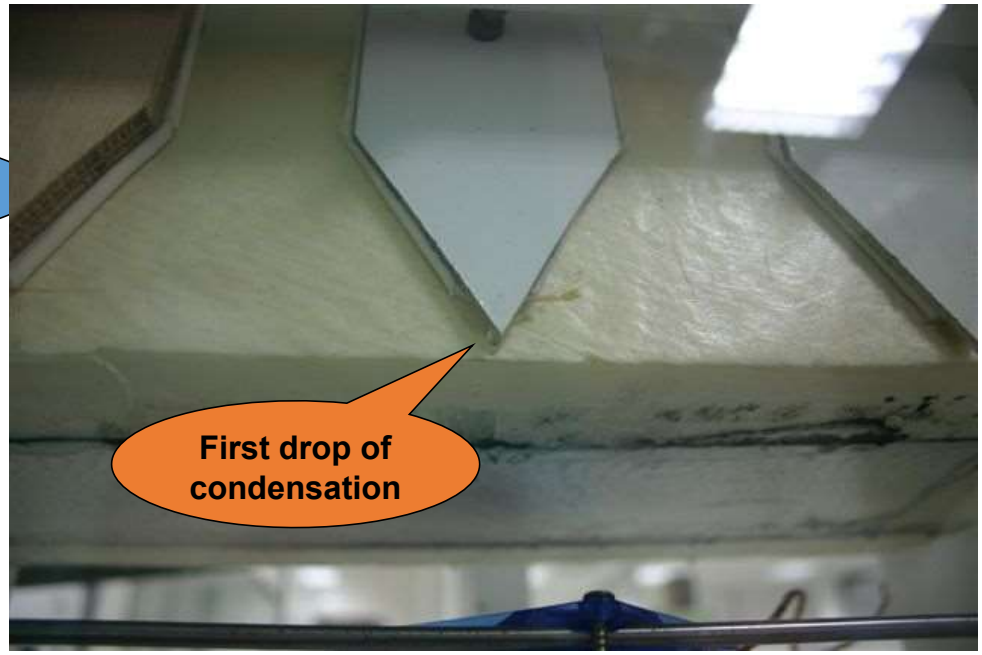
- ✓ Retard condensation
- ✓ Warm touch
- ✓ Low density
- ✓ Low sag
- ✓ Low shrink
- ✓ Silky decorative aspect
- ✓ Easy to brush on, to roll on

Recommended microspheres: K1 – K15 - K20 – S22 – K25

3M™ Glass Bubbles in Paints

Anti-Condensation Paint

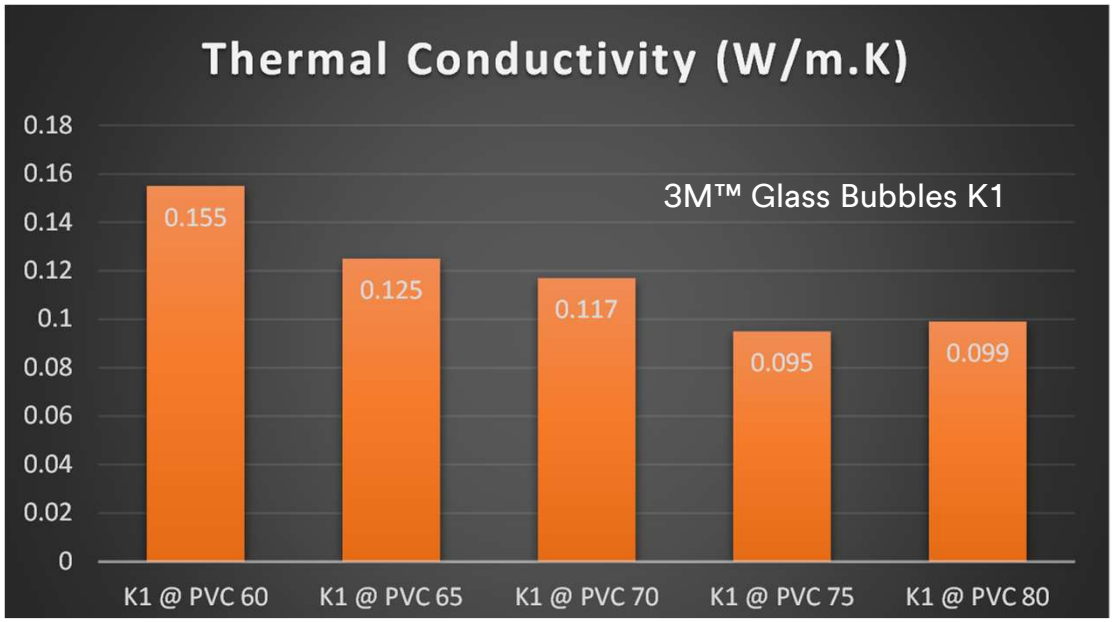




Standard Paint:	24 min
Anti-Condensation Paint:	41 min

3M™ Glass Bubbles in Paints

Thermal Insulation / Low Effusivity Comfort Paint



Thermal conductivity in dependence of pigment volume concentration (PVC), 10% TiO_2

$$e = \sqrt{\lambda \cdot \rho \cdot c_p}$$

e: effusivity
λ: thermal conductivity
ρ: density
c_p: heat capacity

Effusivity is a measure of a materials ability to exchange thermal energy with its surroundings

$$T_m = T_1 + (T_2 - T_1)\frac{e_2}{(e_2 + e_1)}$$

3M™ Glass Bubbles in Paints

Thermal Insulation / Low Effusivity Comfort Paint

Recommended microspheres: K1 – K15 – K20 – S22 – K25 – S28HS

Advantages/Benefits:

- ✓ Reduced thermal conductivity
- ✓ Help eliminate thermal “bridges”
- ✓ Higher wall temperature
- ✓ Warm feel (low effusivity e)

$$e = \sqrt{\lambda \cdot \rho \cdot c_p}$$

e: effusivity
λ: thermal conductivity
ρ: density
c_p: heat capacity

Effusivity is a measure of a materials ability to exchange thermal energy with its surroundings

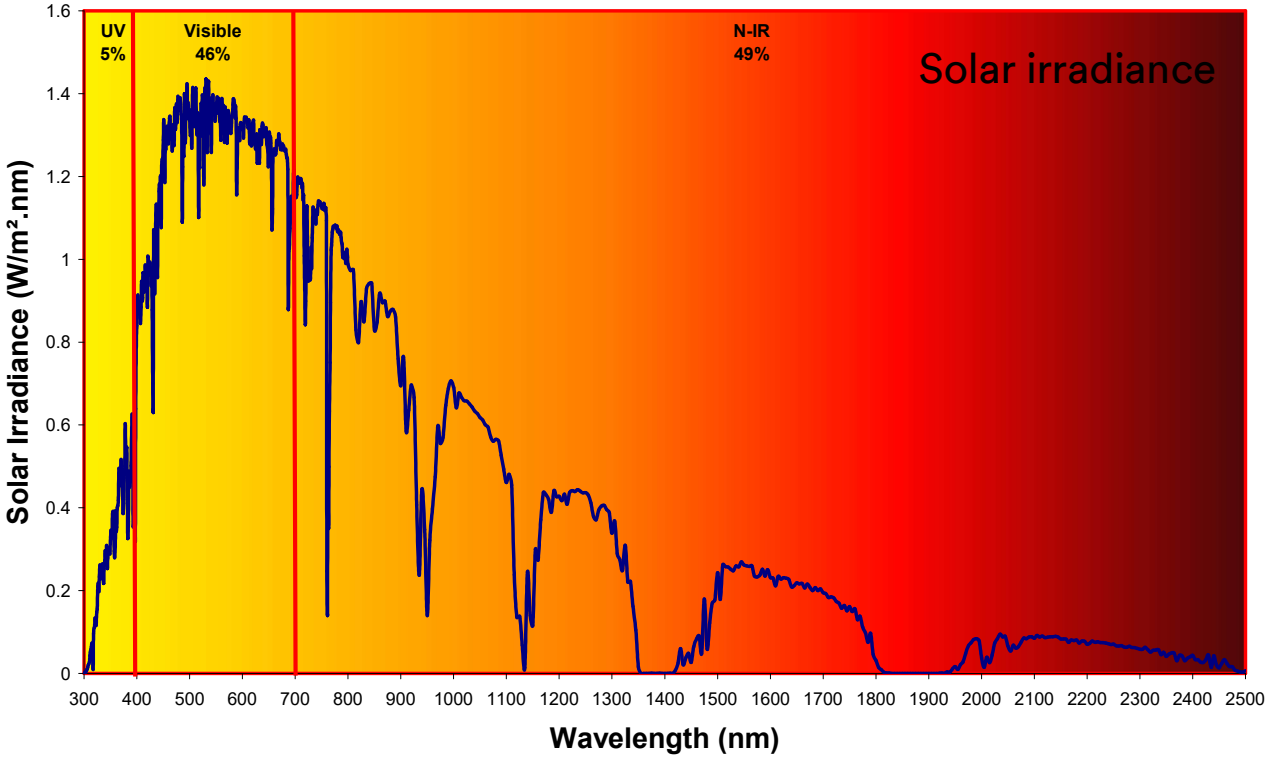
$$T_m = T_1 + (T_2 - T_1)\frac{e_2}{(e_2 + e_1)}$$

3M™ Glass Bubbles

Hollow Glass Microspheres

Applications in Exterior Paints

Solar Heat Reflective Paint



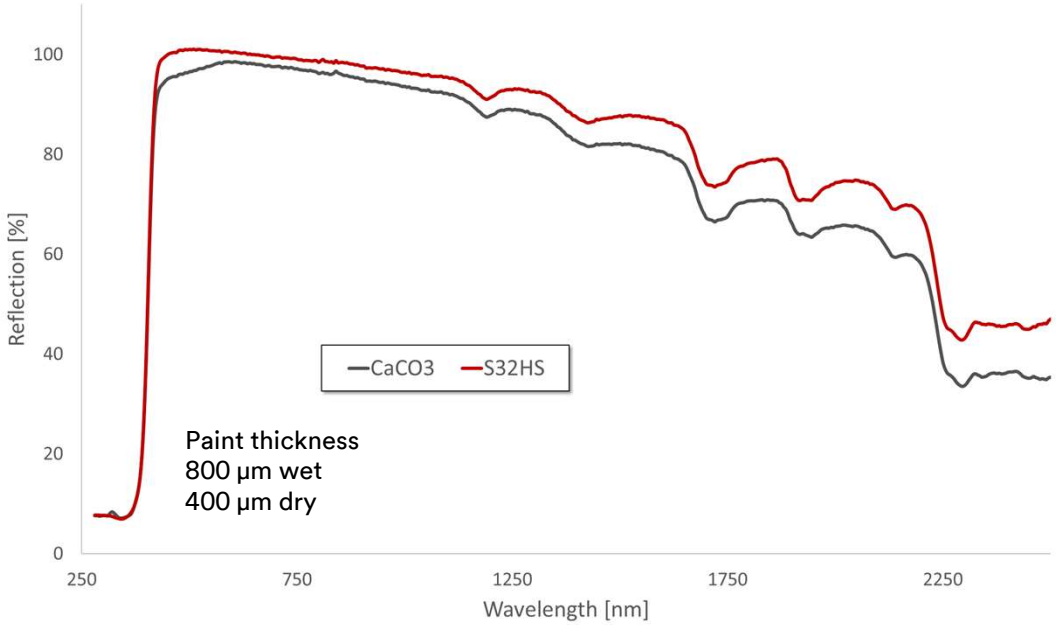
Solar Heat Reflective Paint

Test Equipment

Spectrophotometer Perkin-Elmer 950 UV – Visible - N-IR + Integrated Sphere

Solar Heat Reflective Paint

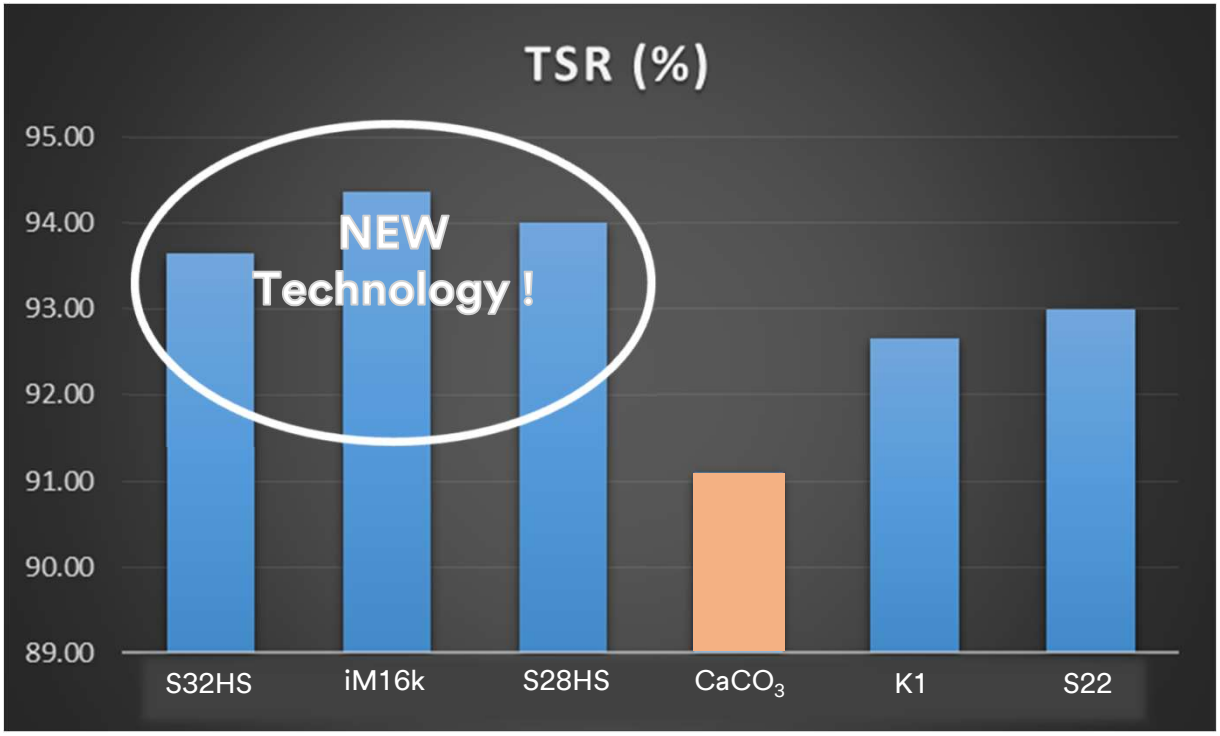
UV-Vis-NIR Photospectrometry



Sample	TSR (%)	UV (%)	Visible (%)	IR (%)
S32HS	93.65	13.89	99.22	93.81
iM16K	94.37	13.67	99.98	94.56
S28HS	94.01	13.72	99.77	94.04
CaCO3	91.09	13.47	97.03	90.80
K1	92.65	14.35	98.78	92.23
S22	93.00	13.92	98.70	92.99

Solar Heat Reflective Paint

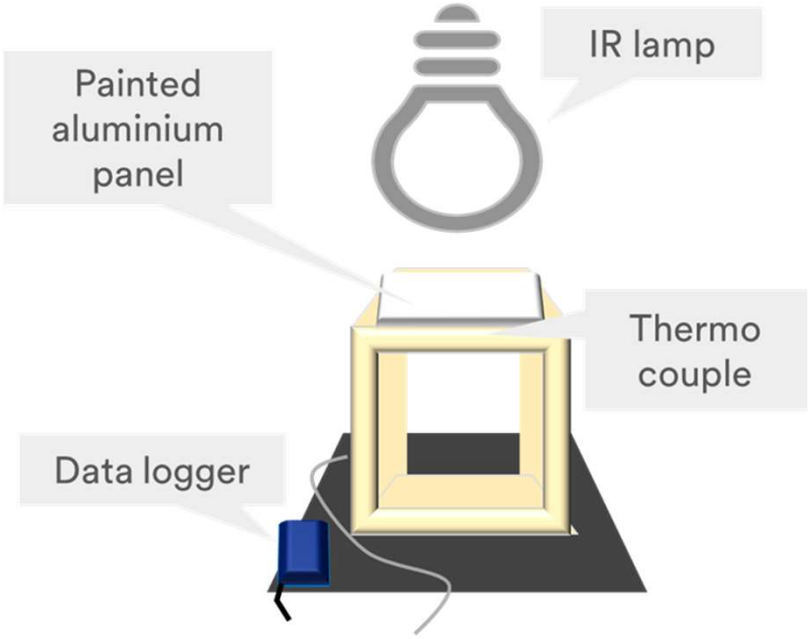
Total Solar Reflectance

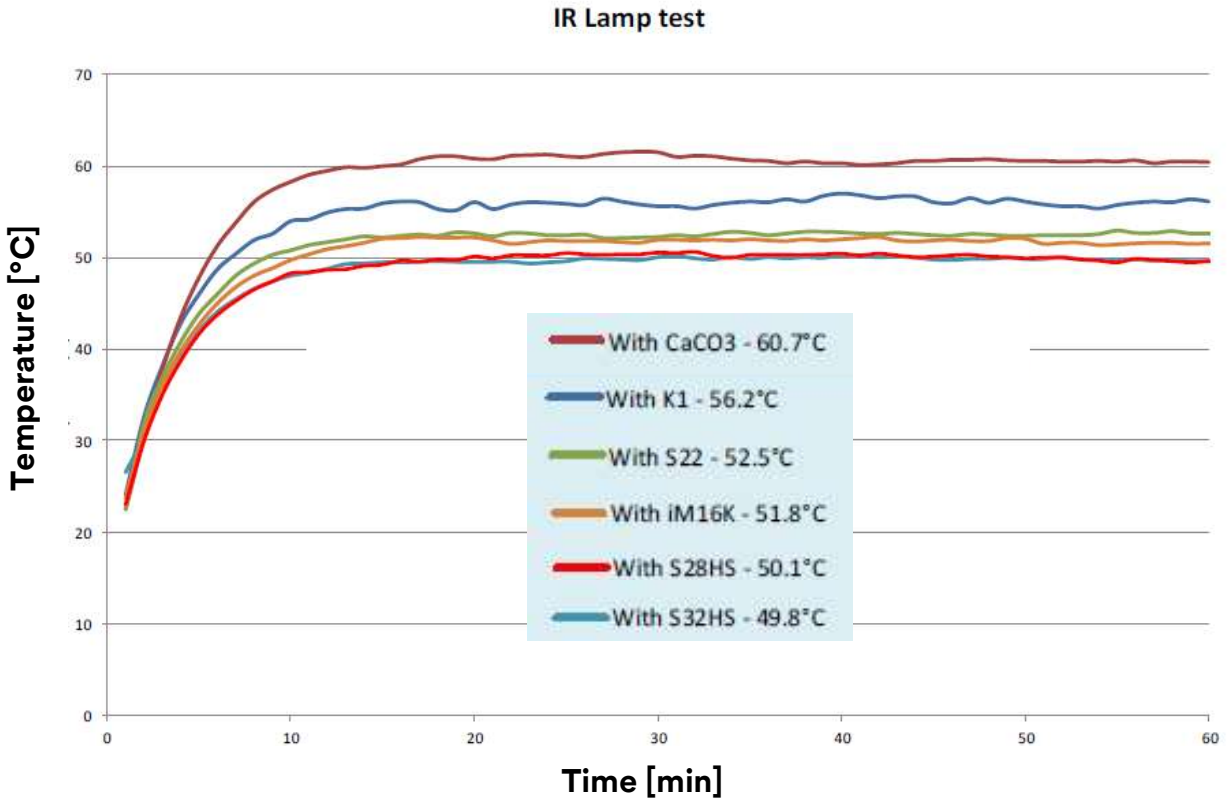


Total solar reflectance (TSR) for paints with various Glass Bubble grades in comparison to $CaCO_3$

Solar Heat Reflective Paint

Backside temperature vs time





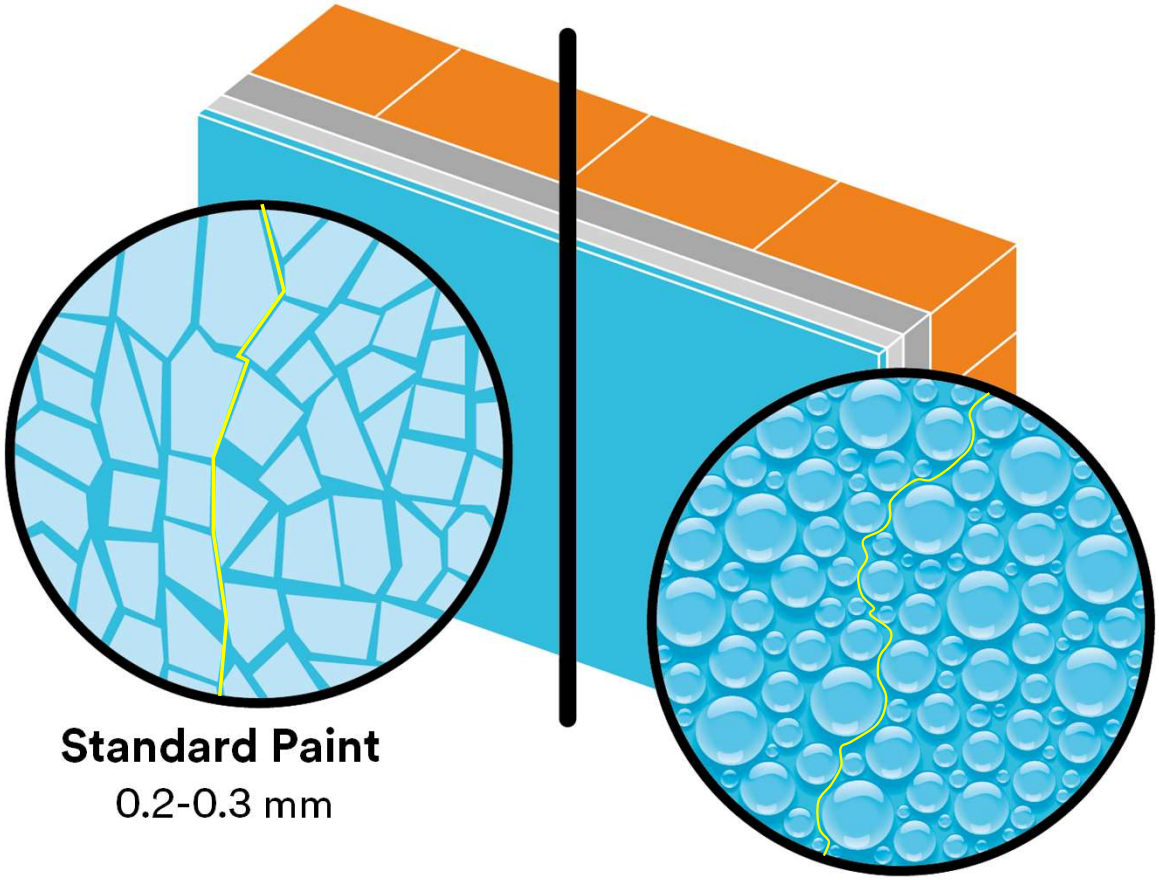
3M™ Glass Bubbles in Solar Heat Reflective Paint

Potential Applications

- Façade paint
- Roof coatings
- External wall insulation systems
- Mobile-home, caravans
- Refrigerated storage warehouses
- Refrigerated trucks
- Oil & Gas outdoor storage tanks
- Cryogenic tanks and tankers
- Gel coats for pleasure boat cabins
- Etc.....

Cracks & Modulus

- State of the art buildings (e.g., with insulating masonry) use structural materials with lower modulus
- Façade materials like plaster and paint need lower modulus, too
- Modulus gradient required to avoid cracks



Cracks & Consequences

- Cracks facilitate algae growth
- Avoiding formation of micro-cracks is key to protect façades from algae

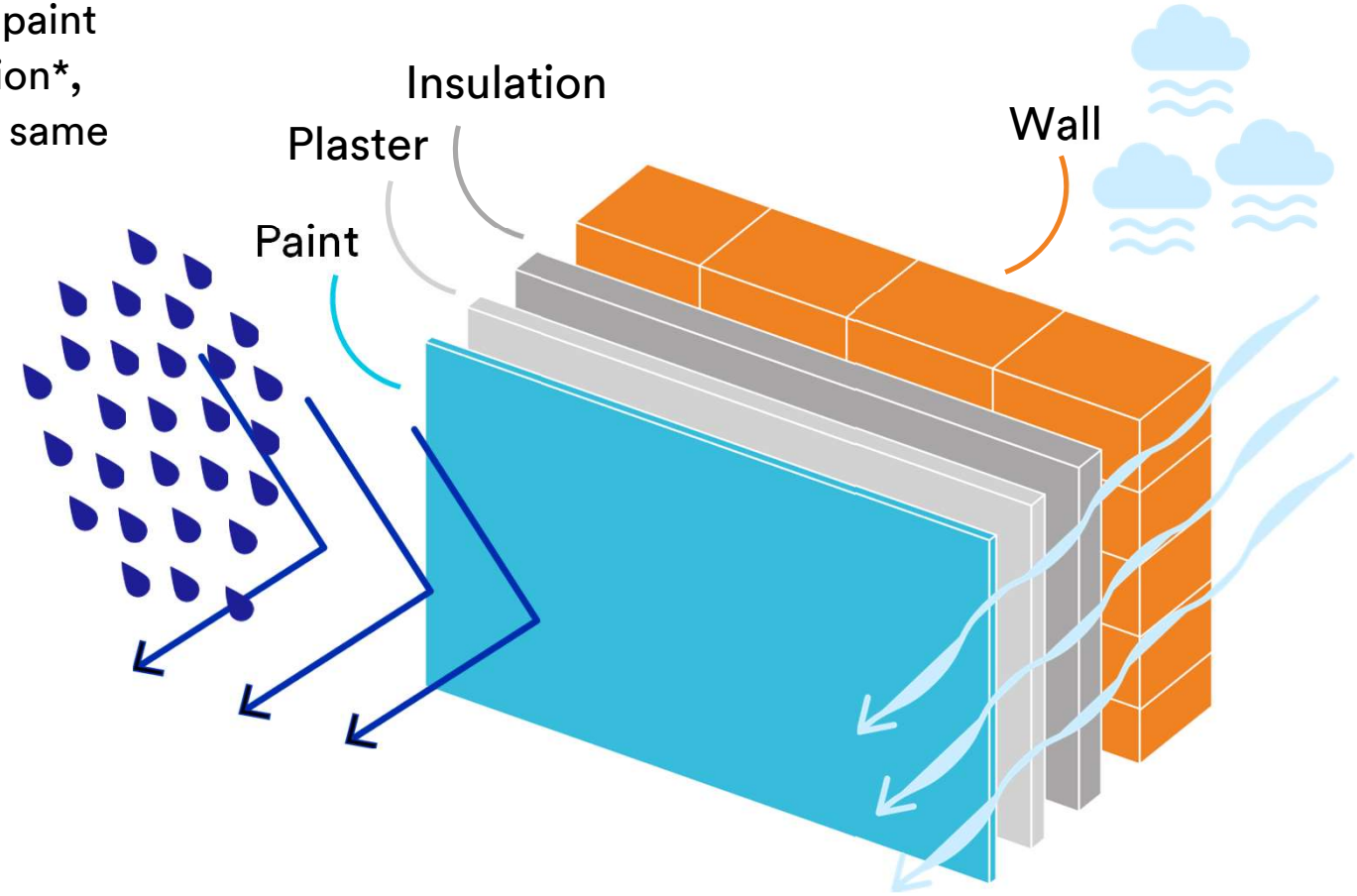
Before

After

Moisture Management – “The membrane-principle”

Glass Bubbles can help to formulate a paint with very good water vapor transmission*, and good barrier vs liquid water at the same time

- Protect façades
- Keep masonry and insulation dry
- Preserve the building structure
- Foster healthy living climate



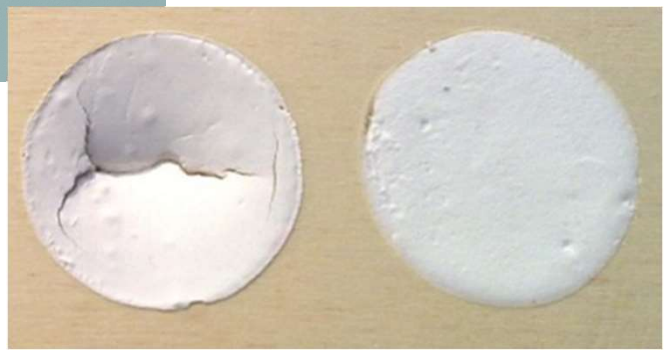
* = low s_d value

3M™ Glass Bubbles

Hollow Glass Microspheres

Applications in Spackles and Wall Fillers

3M™ Glass Bubbles in Spackles & Wall Fillers



Advantages/Benefits:

- High opacity
- High filler contents
- Low shrinkage
- No cracks
- Low density
- Low sagging
- Workability
- Sandability
- Nail & screw: no cracks
- Labor cost saving

Recommended microspheres: K1 – K15 – K20 – S22 – S28HS

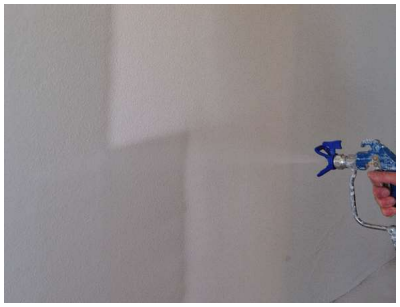
3M™ Glass Bubbles in *"Airless Sprayable"* Compounds

New

3M™ Glass Bubbles S28HS
density: 0.28 g/cm³
d_{50}: 30 µm
collapse strength: 21 MPa

Proof of concept
- Wagner PS 3.39 Airless Spraypack
- Working pressure: 200 bar

=> Superior survival compared to other lightweight fillers like perlite (90% vs. 50%)



Advantages/Benefits
- ✓ High opacity
- ✓ Withstands airless pressure
- ✓ Low shrinkage
- ✓ No cracks
- ✓ Low density
- ✓ Low sagging
- ✓ Workability
- ✓ Sandability
- ✓ Nail & screw: no cracks
- ✓ Labor cost saving

Recommended microspheres: S28HS

3M™ Glass Bubbles

Hollow Glass Microspheres

Applications in Industrial Insulation

3M™ Glass Bubbles in Thermal Protective Coatings

Advantages/Benefits:

- ✓ Personal burn protection
- ✓ Prevent/eliminate CUI (Corrosion Under Insulation)
- ✓ Thermal conductivity as low as 0.10 W/m.K
- ✓ High Solids
- ✓ Greater dry coating thickness
- ✓ Airless sprayable using high strength glass bubbles
- ✓ Reduced shrinkage
- ✓ Reduced VOC

Recommended microspheres: K1 – K15 – K20 – K25 – S28HS

Official Distributor of 3M™ Glass Bubbles in Hungary

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GENDORF Chemical Park, Germany
with 3M™ Specialty Additives Laboratory

Thank You

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