SOLKANE® 365
Solar Water Heater Production

SOLKANE®

The Chinese solar water heater industry and HCFC 141b phase-out

The Chinese solar water heater industry is currently using HCFC141b as a blowing agent to produce rigid foam for water tank insulation. According to the new schedule of the Montreal Protocol, the HCFCs phase-out in developing countries will happen 10 years earlier. In view of its 30 % growth rate and its scale, which represents 80 % of the global output, the Chinese environmental protection department has included solar water heaters as one of the priorities for HCFC 141b phase-out within the PU foam industry. Therefore, solar water heater manufacturers are trying different new blowing agents to develop their own technology to prepare for the conversion.

Sangle – its alternative selection

Having compared different blowing agents, Sangle believes that SOLKANE® 365/227 should be very suitable for solar water heater applications due to its advantages, such as 0 ODP, high boiling point for easy processing, low thermal conductivity, outstanding compressive strength and no requirement for equipment modification. In the second half of 2009, Sangle together with Dongda and Solvay started trials for the use of SOLKANE® 365/227 in solar water heater production to find an effective way for the replacement of HCFC 141b within the industry.

Dongda – 365/227 based PO development

With respect to the technical requirements of Sangle, Dongda developed a SOLKANE® 365/227 based Polyol system and tested it several times at Sangle's production line for optimization.

1. Experiment conditions

Equipment	Standard	Parameter
Blowing machine	OMS high pressure	flux: 600 g/s injection pressure: 120 – 130 MPa Mat. Temp. (P/I): 21±3°C/21±3°C
Water tank	1800 mm x 20 tubes	Filling pressure: 0.24 MPa
Cold storage	–40 °C	

2. Experimental formulation

Material	pbw
Polyether	100
Foam stabilizer	2.0 – 2.5
Catalyst	1.0 – 3.0
Water	1.8 – 2.2
HFC-365/227	15 – 20
Isocyanate	Index 1.05– 1.10

Results analysis

1. PO structure & bonding performance

During the foaming process on water tanks, foam should have good adhesion to colored steel sheet. Separation of the two parts would be disastrous for the product quality. It was discovered in these trials that blending polyols of different structures cannot only reduce effectively the brittleness of the foam surface, but also improve both the bonding strength and the compressive strength of foam. Results are as follows:

Polyether	Ratio	Density kg/m^3	Compressive strength kPa	Foam Performance
A/D	80/20	34.1	140	debonding, serious shrinkage
A/C	90/10	33.5	170	slight debonding, no shrinkage
B/C	90/10	33.1	175	slight debonding, no shrinkage
A/B/C	75/15/10	34.5	169	strong adhesion, no shrinkage

Polyether A, B
(OH: 380 ± 10mg KOH/g)
Polyether C
(OH: 110 ± 10mg KOH/g)
Polyether D
(OH: 160 ± 10mg KOH/g)

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2. Additives selection

In Polyol systems, foam stabilizers and catalysts are of critical importance for the foam quality and foaming process. For SOLKANE®365/227 foaming, it was found during the experiments that the use of mixed catalysts DC13/DC12/DC17 and B8538 stabilizer can improve the product quality and foaming process.

3. Foam properties

Blowing Agent	141b	365/227	CP
Overall density kg/m^3	55	47	52
Core density kg/m^3	42	38	37
λ at 23 °C mw/m.k	19.1	20.5	22.8
Compressive strength KPa	168	171	161

The above figures show that with 14.5 % density reduction, SOLKANE®365/227 based foam can provide the same compressive strength as the HCFC 141b system and a lower thermal conductivity than the cyclo-pentane version.

4. Low temperature resistance performance

The SOLKANE®365/227 based water tank was placed in a cold storage room to test breaking, shrinkage and debonding of the foam. It was proved that after 72 hours of storage at –5°C – 25°C, its dimensional stability was good at low temperature, and that the product meets the requirements for use in winter time.

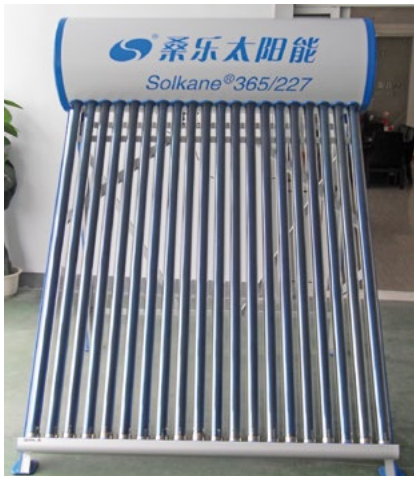
Conclusion

SOLKANE®365/227 based foam can satisfy the requirements of the solar water heater industry in terms of its product quality and production process with the following benefits:

- Foam density 15 % reductioncompared with HCFC 141b 10 % reduction compared with pentane
- Lambda 10 % lower than Cp

Based on the above-mentioned results and rough estimates of replacement cost (replacing HCFC 141b with SOLKANE® 365/227, the cost increase can be minimized to RMB 14 per unit), Sangle has considered using SOLKANE®365/227 for a batch of scale production for the purpose of process optimization.

Three parties believe that HFC 365/227 as Blowing Agent used in solar WH has its unique advantages for the technology conversion within the solar water heater industry. For the HCFC 141b phase-out target, HFC 365/227 can ease the transition with no safety concerns or investment burdens for manufacturers, leaving room for their further development in future.



Solar heater made by Sangle in China.

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