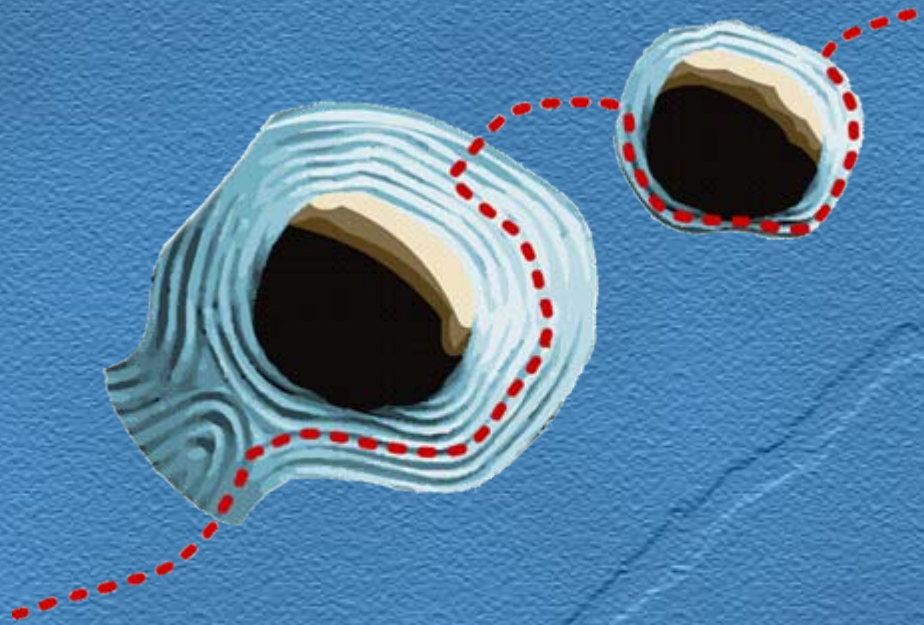


PCM's for thermal insulation and energy storage

João A. P. Coutinho, Carlos P. Neto

CICECO, Dep. de Química, Universidade de Aveiro

What is a PCM?

Phase transition

"Melting/Crystallization heat"

Ice-Water: $\Delta H = 333$ kJ/kg

at 0°C

333 kJ/kg

Temperature difference

"Heat capacity"

Water: $c_p \approx 4.2$ kJ/kg · K

1°C → 80°C

332 kJ/kg

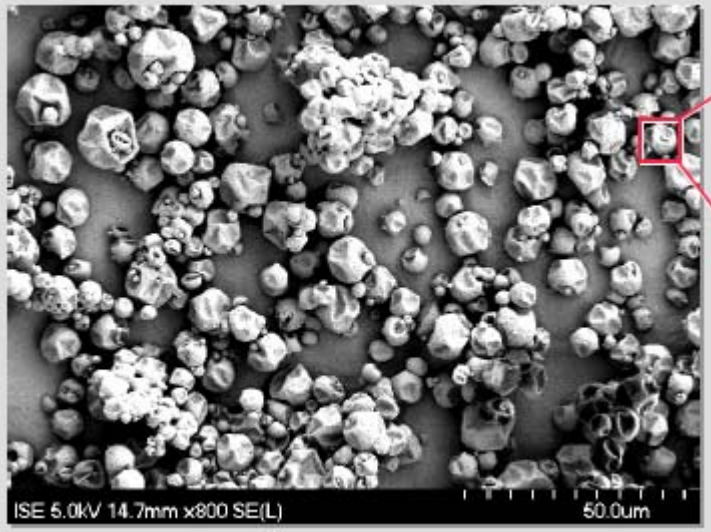
Potential PCMs

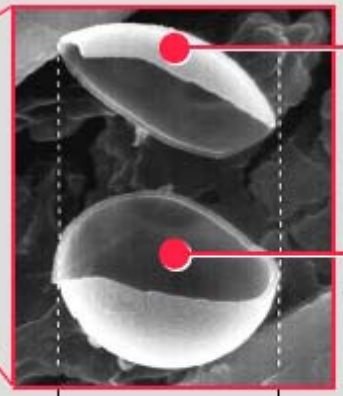
Table 7
Commercial PCMs available in the market

PCM name	Type of product	Melting temperature (°C)	Heat of fusion (kJ/kg)	Density (kg/m³)	Source
SN33	Salt solution	−33	245	1.24	Cristopia [41]
TH-31	n.a.	−31	131	n.a.	TEAP [42]
SN29	Salt solution	−29	233	1.15	Cristopia [41]
SN26	Salt solution	−26	268	1.21	Cristopia [41]
TH-21	n.a.	−21	222	n.a.	TEAP [42]
SN21	Salt solution	−21	240	1.12	Cristopia [41]
STL-21	Salt solution	−21	240	1.12	Mitsubishi Chemical [43]
SN18	Salt solution	−18	268	1.21	Cristopia [41]
TH-16	n.a.	−16	289	n.a.	TEAP [42]
STL-16	n.a.	−16	n.a.	n.a.	Mitsubishi Chemical [43]
SN15	Salt solution	−15	311	1.02	Cristopia [41]
SN12	Salt solution	−12	306	1.06	Cristopia [41]
STLN10	Salt solution	−11	271	1.05	Mitsubishi Chemical [43]
SN10	Salt solution	−11	310	1.11	Cristopia [41]
TH-10	n.a.	−10	283	n.a.	TEAP [42]
STL-6	Salt solution	−6	284	1.07	Mitsubishi Chemical [43]
SN06	Salt solution	−6	284	1.07	Cristopia [41]
TH-4	n.a.	−4	286	n.a.	TEAP [42]
STL-3	Saltsolution	−3	328	1.01	Mitsubishi Chemical [43]
SN03	Saltsolution	−3	328	1.01	Cristopia [41]
ClimSel C 7	n.a.	7	130	n.a.	Climator [44]
RT5	Paraffin	9	205	n.a.	Rubitherm GmbH [45]
ClimSel C 15	n.a.	15	130	n.a.	Climator [44]
ClimSel C 23	Salt hydrate	23	148	1.48	Climator [44]
RT25	Paraffin	26	232		Rubitherm GmbH [45]
STL27	Salt hydrate	27	213	1.09	Mitsubishi Chemical [43]
S27	Salt hydrate	27	207	1.47	Cristopia [41]
RT30	Paraffin	28	206	n.a.	Rubitherm GmbH [45]
TH29	Salt hydrate	29	188	n.a.	TEAP [42]
ClimSel C 32	Salt hydrate	32	212	1.45	Climator [44]
RT40	Paraffin	43	181	n.a.	Rubitherm GmbH [45]
STL47	Salt hydrate	47	221	1.34	Mitsubishi Chemical [43]
ClimSel C 48	n.a.	48	227	1.36	Climator [44]
STL52	Salt hydrate	52	201	1.3	Mitsubishi Chemical [43]
RT50	Paraffin	54	195	n.a.	Rubitherm GmbH [45]
STL55	Salt hydrate	55	242	1.29	Mitsubishi Chemical [43]
TH58	n.a.	58	226	n.a.	TEAP [42]
ClimSel C 58	n.a.	58	259	1.46	Climator [44]
RT65	Paraffin	64	207		Rubitherm GmbH [45]
ClimSel C 70	n.a.	70	194	1.7	Climator [44]
PCM72	Salt hydrate	72	n.a.	n.a.	Merck KgaA [6]
RT80	Paraffin	79	209	n.a.	Rubitherm GmbH [45]
TH89	n.a.	89	149	n.a.	TEAP [42]
RT90	Paraffin	90	197	n.a.	Rubitherm GmbH [45]
RT110	Paraffin	112	213	n.a.	Rubitherm GmbH [45]

n.a.: not available.

Microencapsulated PCM



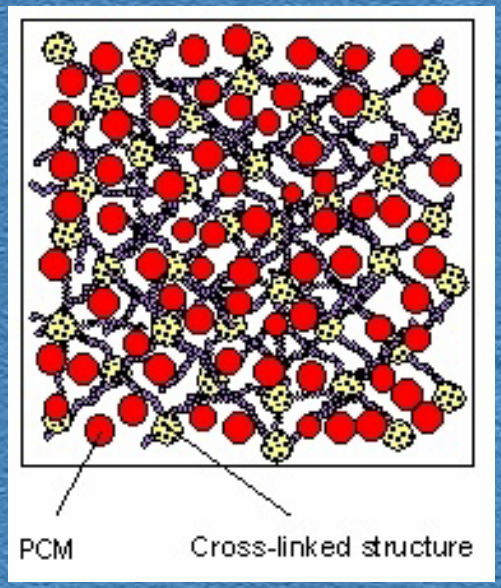


Polymer coating

Wax
Fp: ca. 26°C
Δ H: 110 J/g

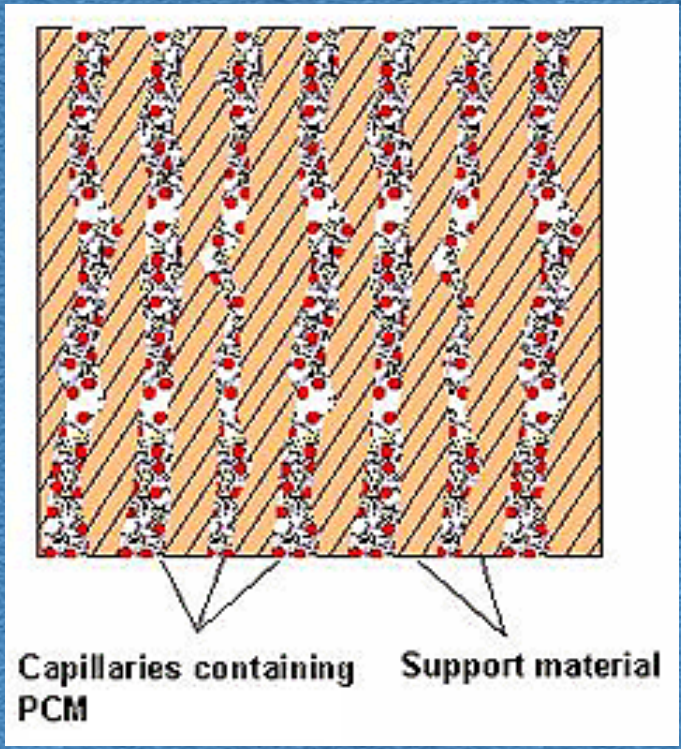
5 µm

Cross-linked on polymer



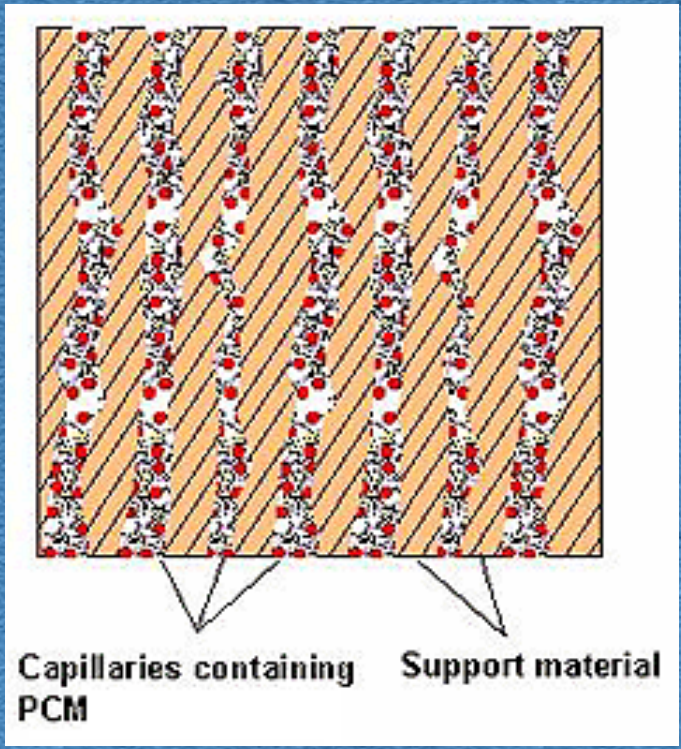
Rubitherm PK

Immobilized on porous support



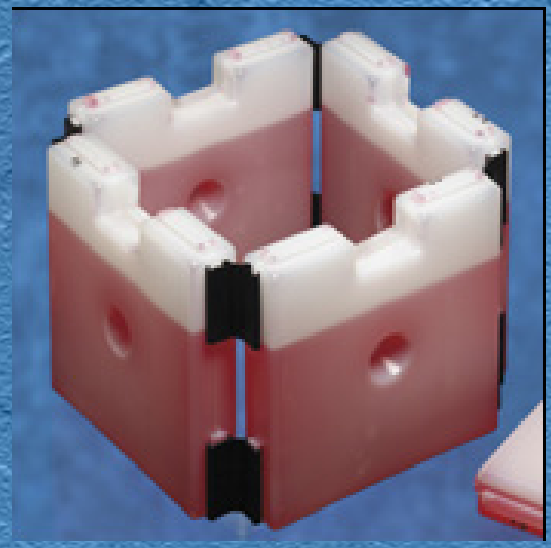
Rubitherm GR

Immobilized on porous support



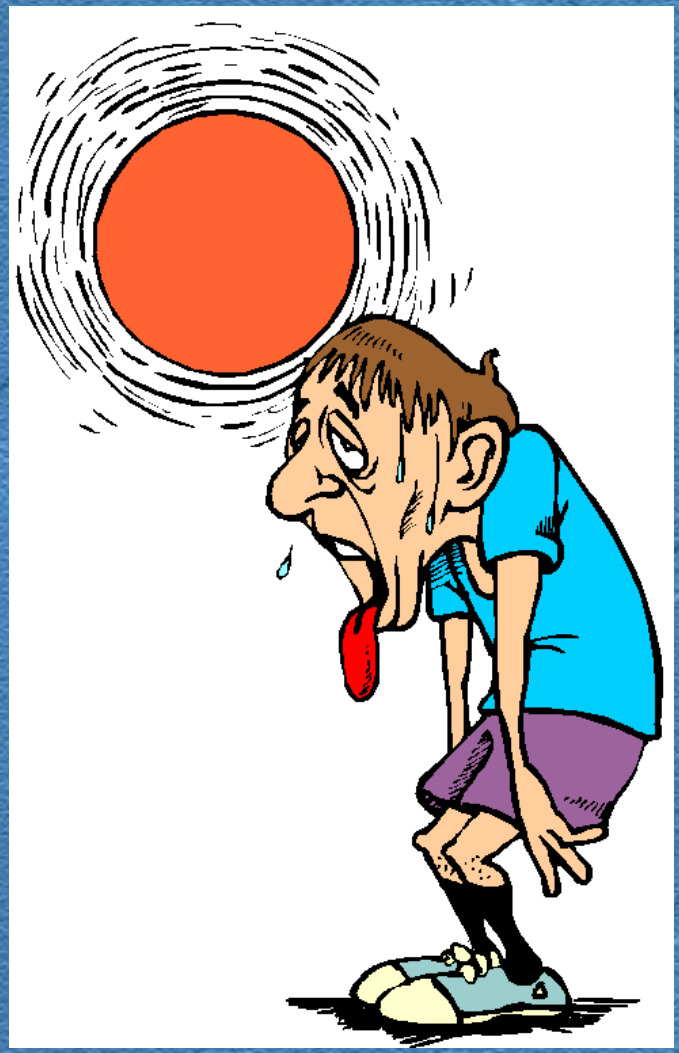
Rubitherm PX

Macroencapsulation of PCMs



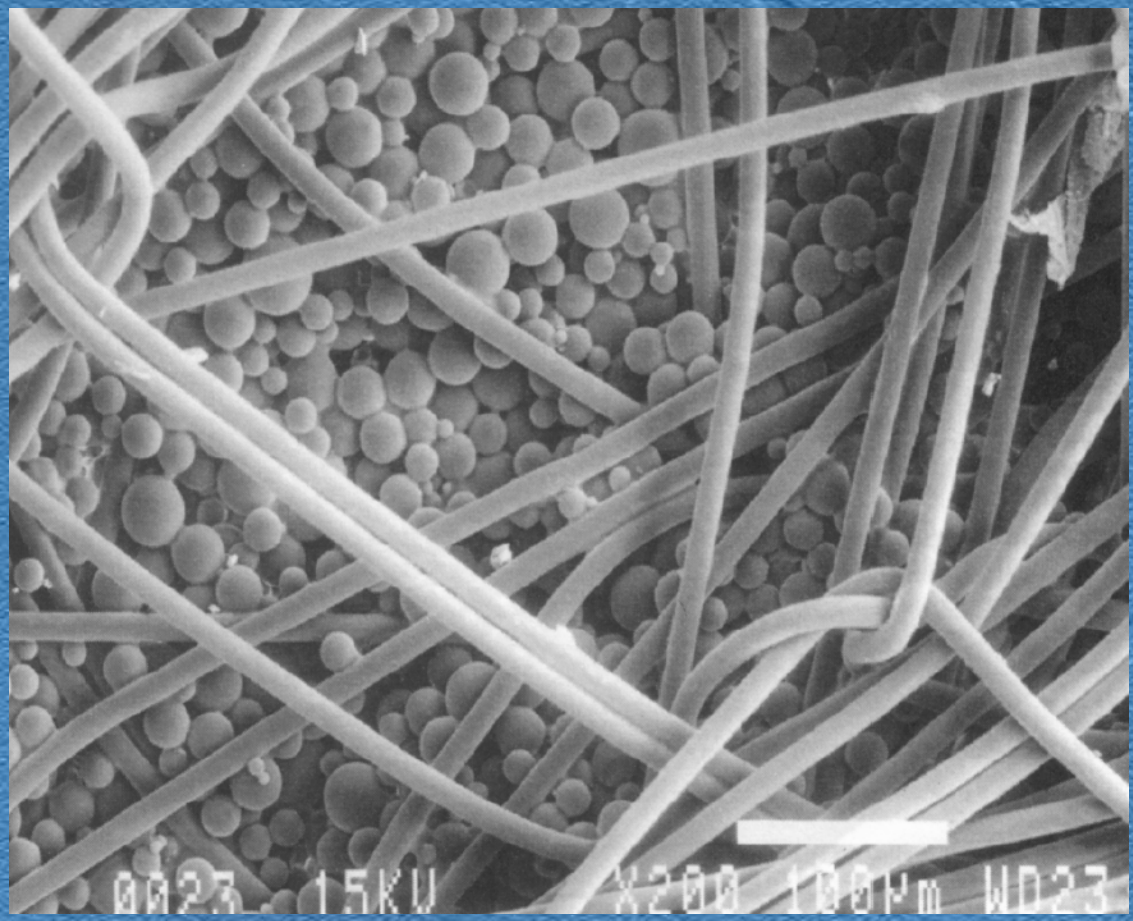
Cork and cellulose composites

PCMs - body temperature control



PCMs in textiles

SmartFabric technology™ | Outlast



PCMs in textiles

Outlast®
ADAPTIVE COMFORT®

DOCKERS
SAN FRANCISCO

QUILTS OF DENMARK®

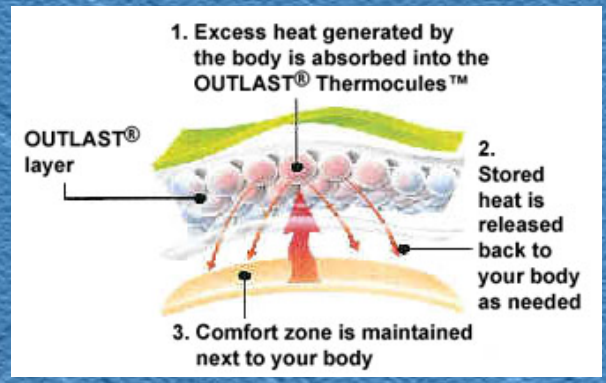
Timberland®
Make it better.™

THE NORTH FACE

pierre cardin

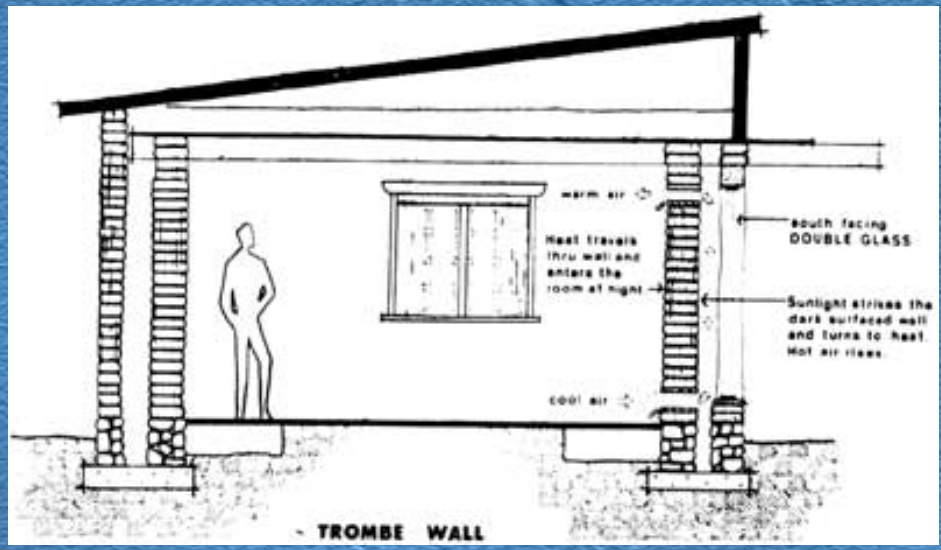
ROMAN ROTHSCHILD OF SWITZERLAND

RAINFOREST

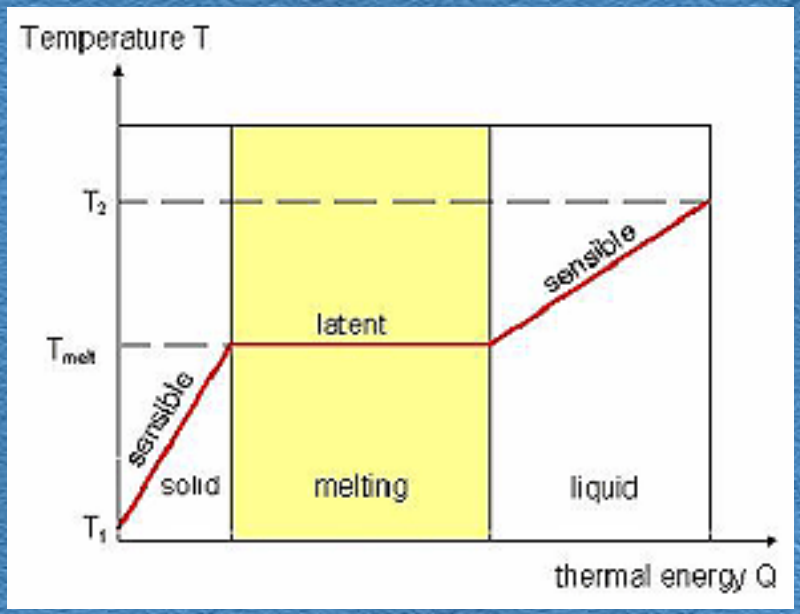


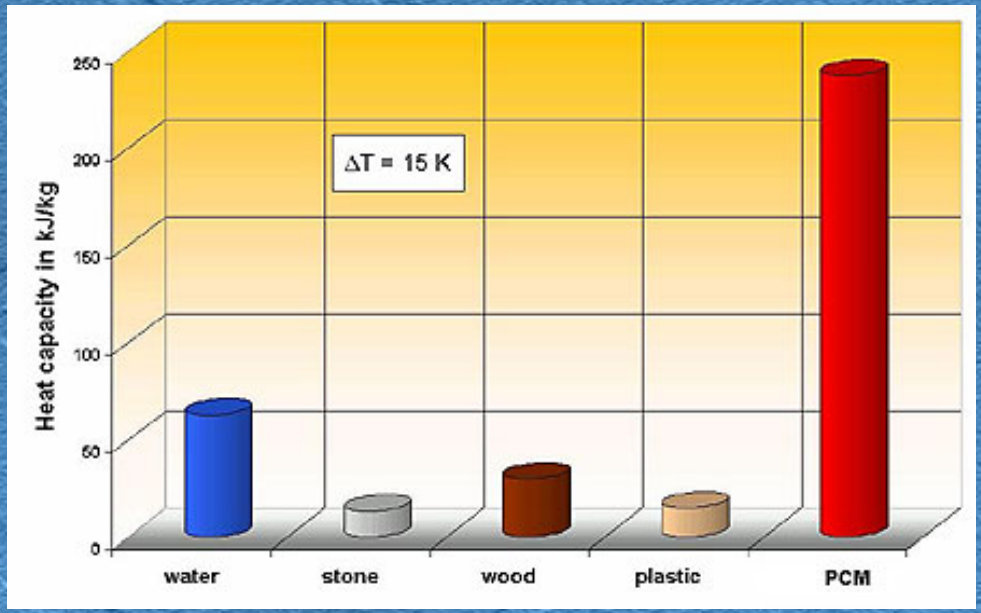
PCMs in building insulation

Trombe wall

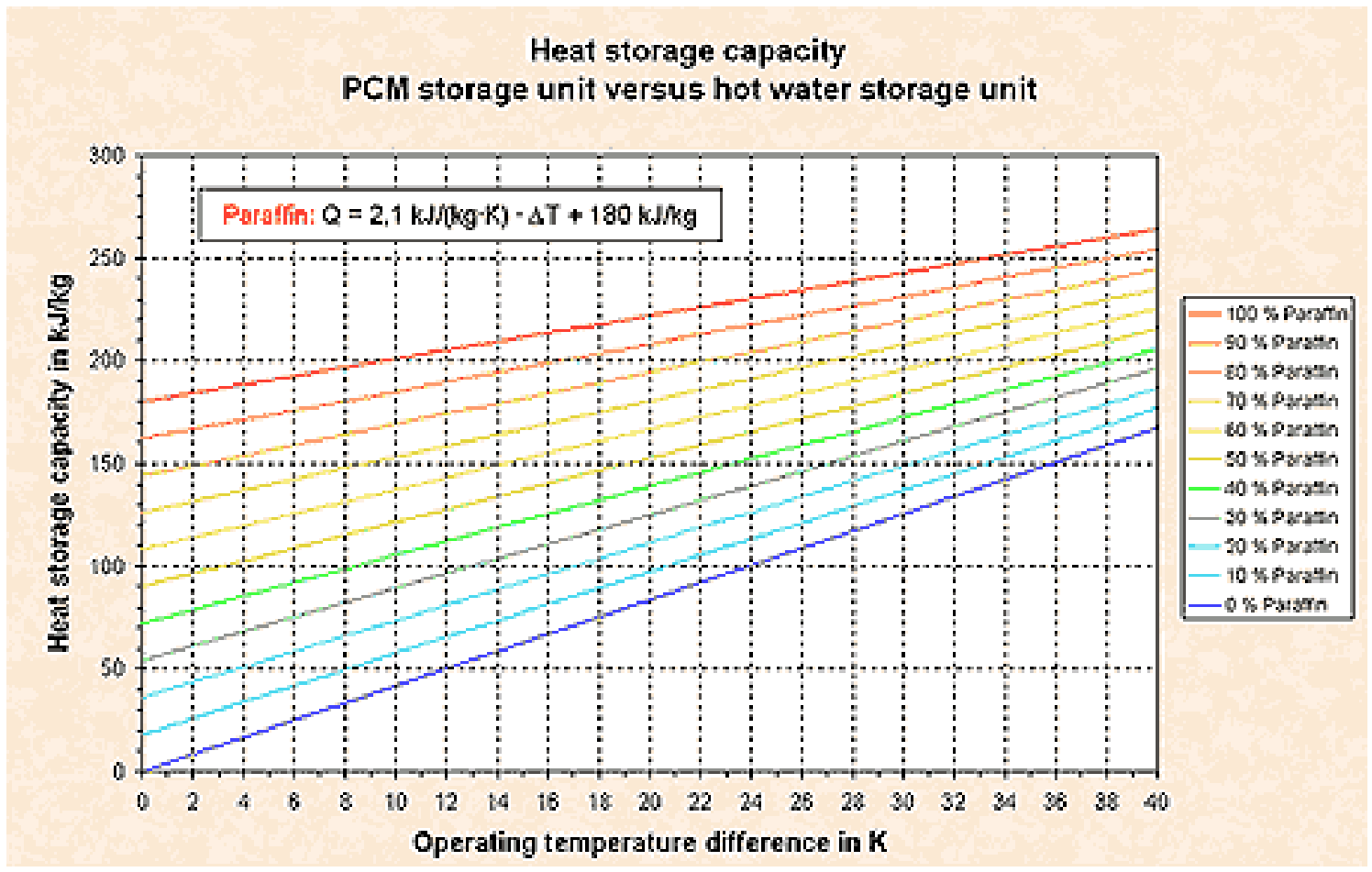

warm air
Heat travels thru wall and enters the room at night
south facing DOUBLE GLASS
Sunlight strikes the dark surfaced wall and turns to heat. Hot air rises
cool air
- TROMBE WALL

Latent vs. sensible heat storage

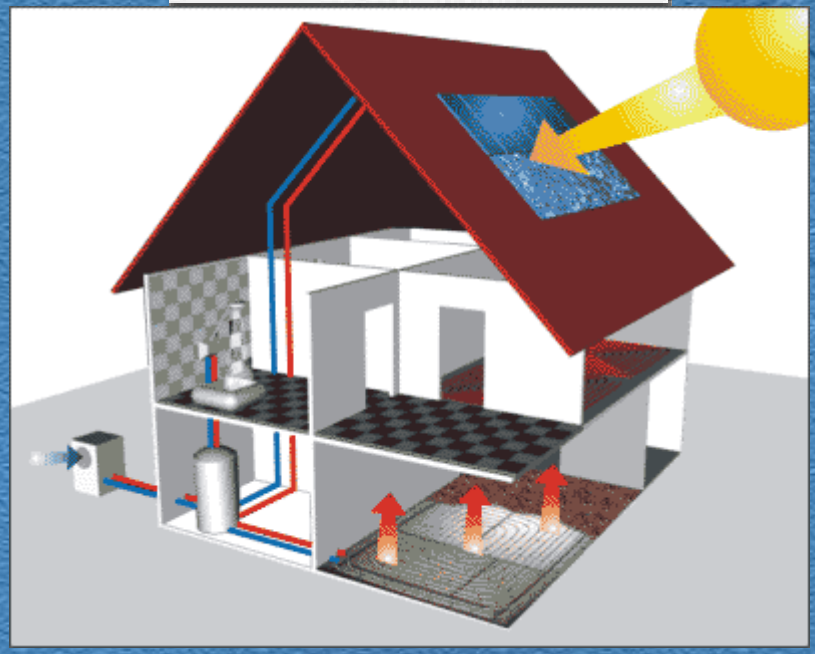




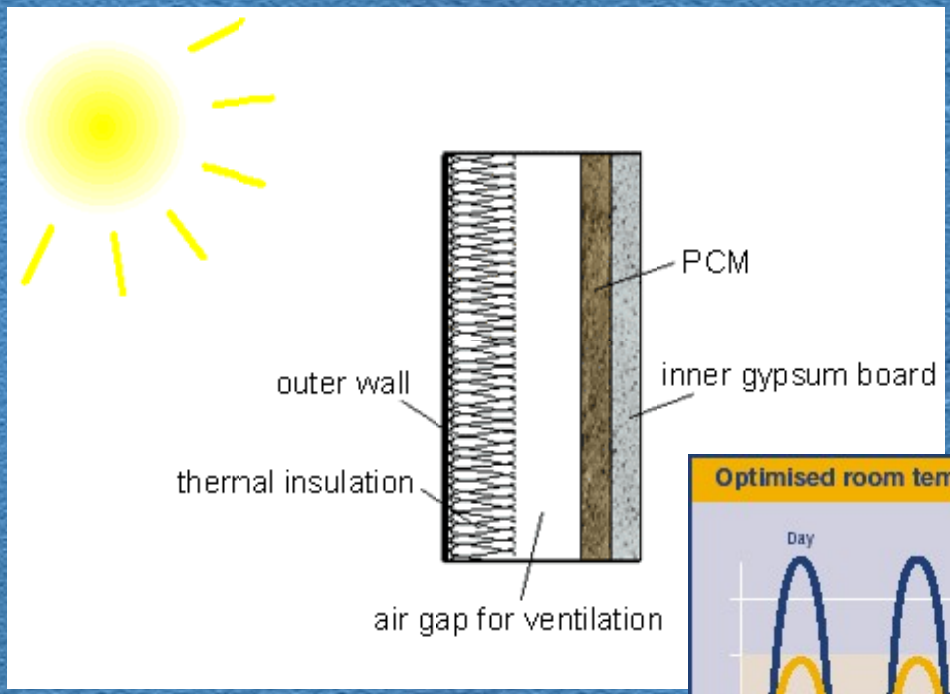
Heat storage

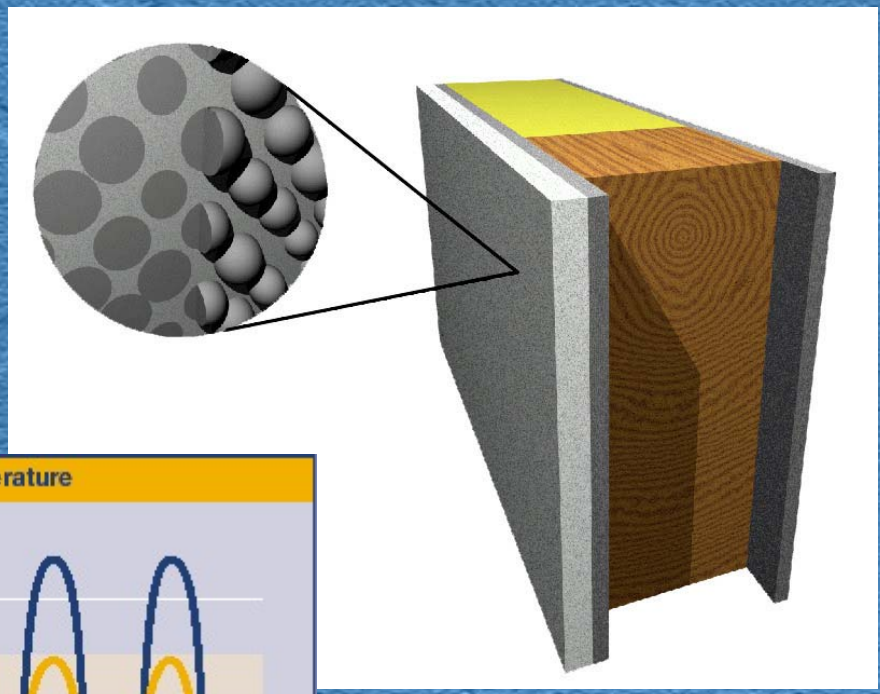


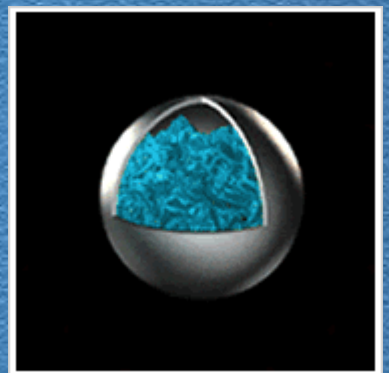
PCM on the roof or floor

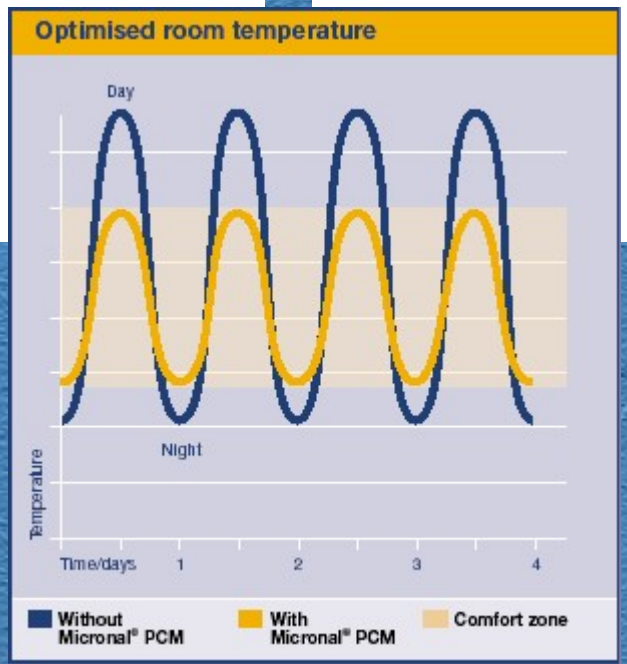


PCMs on the wall









THE 3-LITER-HOUSE –
An innovation in the modernization of old properties

LUWOGE
BASF Gruppe

The air-conditioning system in the wall

An interior plaster with micro encapsulated paraffin is designed to retain latent heat. It ensures that the indoor climate is always comfortable and pleasant.

The heat absorption capacity of two centimeters of this plaster is equivalent to that of a 20 cm thick timer-bricked wall.

Wolfgang Greifenhagen
LUWOGE – Wohnungsunternehmen der BASF GmbH

THE 3-LITER-HOUSE –
An innovation in the modernization of old properties

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BASF Gruppe

Wolfgang Greifenhagen
LUWOGE – Wohnungsunternehmen der BASF GmbH

First commercialized object under passive cooling concept

BASF
The Chemical Company

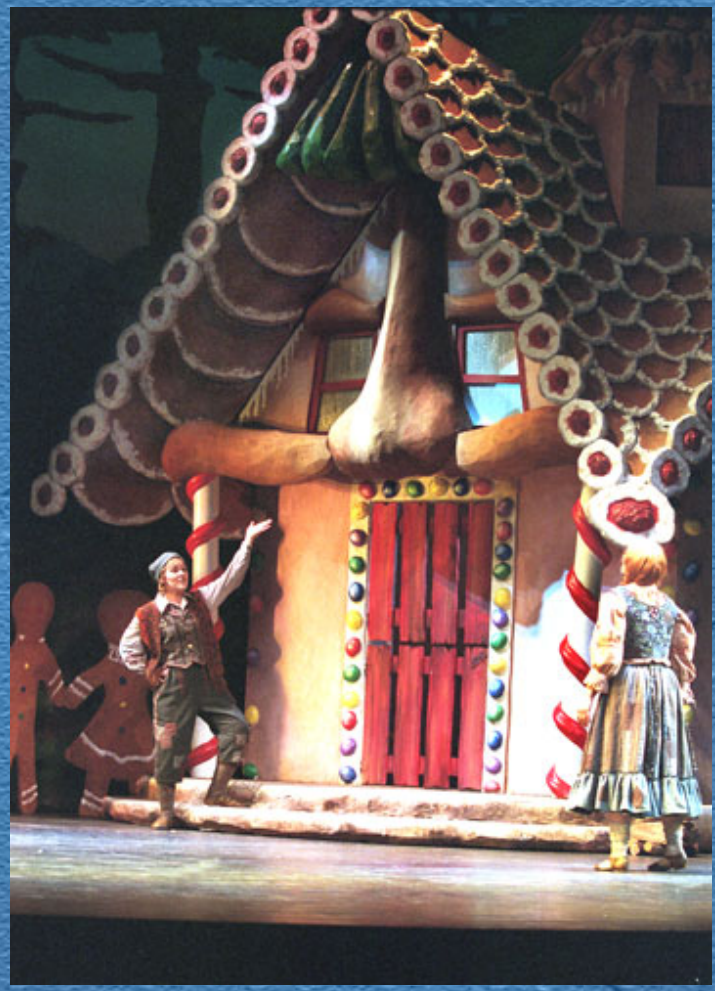
- Newly built office in Offenburg, Badenova,
  Energy concept: Büro Stahl, Freiburg
- "maxit clima" on inner walls (1,200 m²)
- Cooling concept:
  concrete ceilings + night ventilation = passively cooled

First commercialized object under active cooling concept

BASF
The Chemical Company

- Refurbished object: Gotzkowskistraße, Berlin
- Energy concept: Büro EGS Plan, Stuttgart
- Application: *active* climatization for cooling energy conservation
- 1,100 m² “maxit clima” – Plasters in 2 stories
- 7 t Micronal® 23°C processed

On they walked and walked, till suddenly they came upon a strange cottage in the middle of a glade.



"This is chocolate!" gasped Hansel as he broke a lump of plaster from the wall.