Novel polymeric materials for cost-efficient solar-thermal systems

Gernot M. Wallner, R. Buchinger

TASK 54

International Sustainable Energy Conference (ISEC)

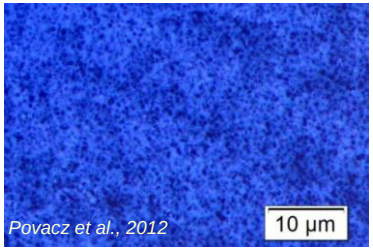
Graz, Austria
3-5 October 2018

JOHANNES KEPLER UNIVERSITÄT LINZ
ipmt

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

New Materials – Tailor-made Absorber Materials

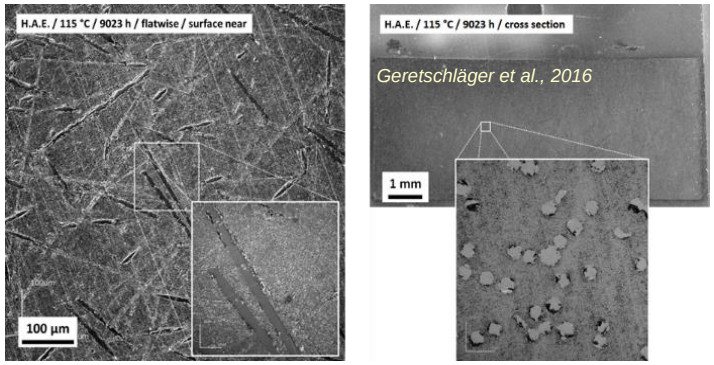
PolyPropylene (PP)



Blockcoplymer +
Carbon black + AO + HALS

BOREALIS

PolyAmide+Glass Fiber (PA-GF)



various suppliers: e.g., Radici, Schulman, BASF

PolyPhenyleneSulfide (PPS)

PPS + PO impact modifier

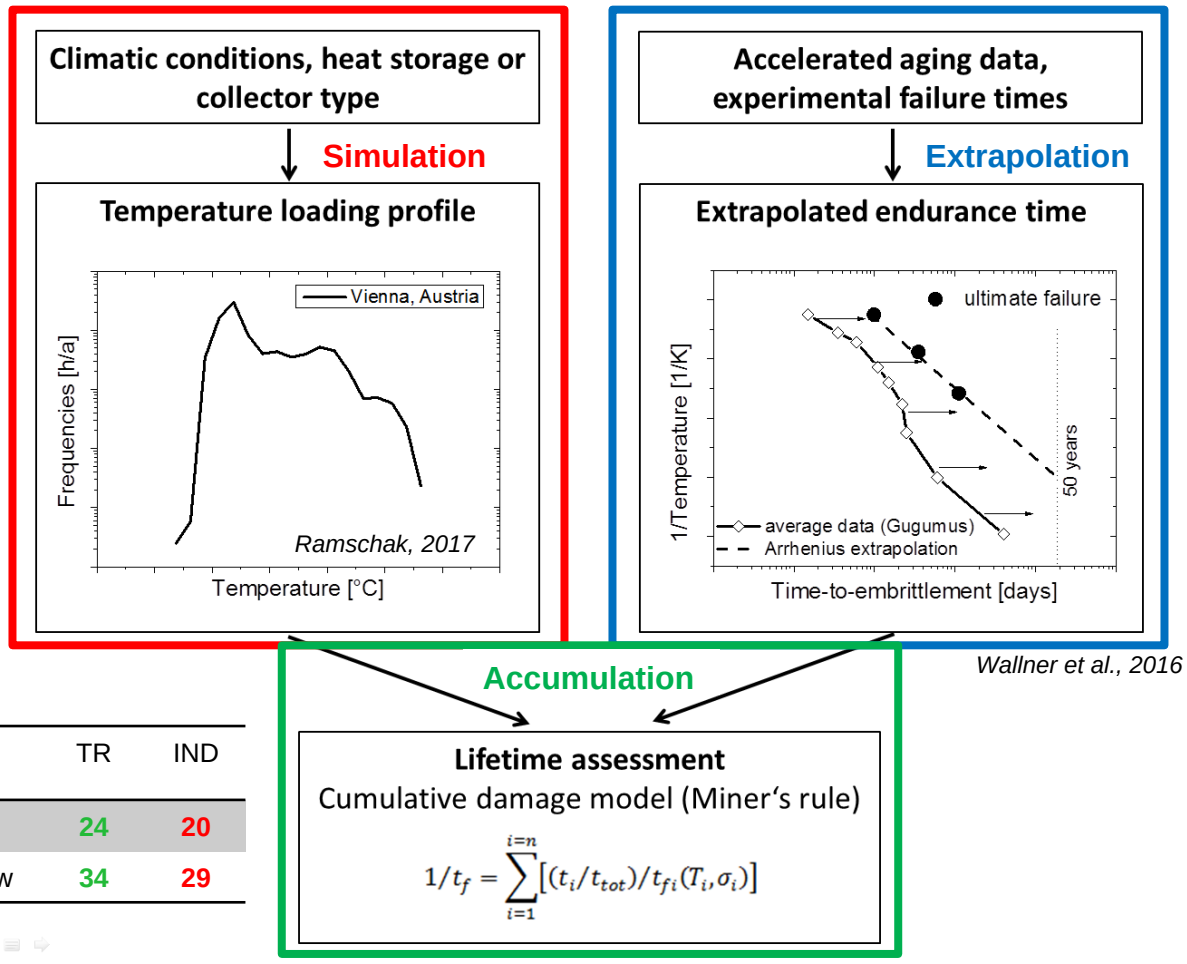
SOLVAY
asking more from chemistry®

Material	T_{Glass}, °C	T_{Melt}, °C	Modulus, MPa RT / 125°C	Strength @RT, MPa	Solar thermal system
PP	-10	165	1200 / 200	25	Low-pressure systems, T_{max}~100°C
PA-GF	-40 to 60	260	5000 / 2000	100	Pressurized systems (< 6bar), T_{max}~100°C
PPS	100	280	1400 / 200	50	Low-pressure systems, T_{max}~150°C

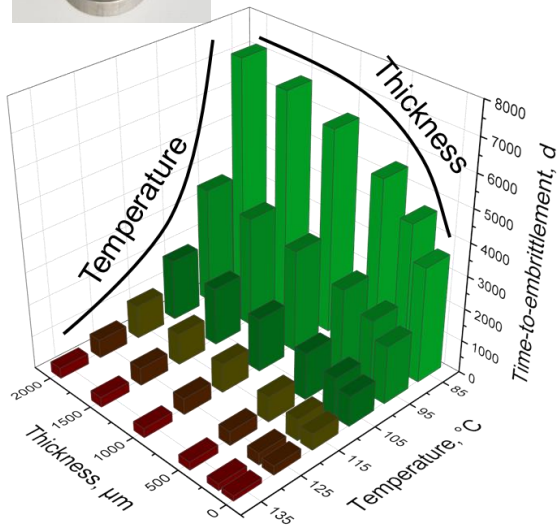
SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY
TASK 54

New Materials – Testing and qualification methods

CUMULATIVE DAMAGE APPROACH (LOW MECHANICAL STRESS)



Wallner et al., 2016



years	TR	IND
PP old	24	20
PP new	34	29

Based on: Diss Povacz (2014); Diss Grabmann (2018)

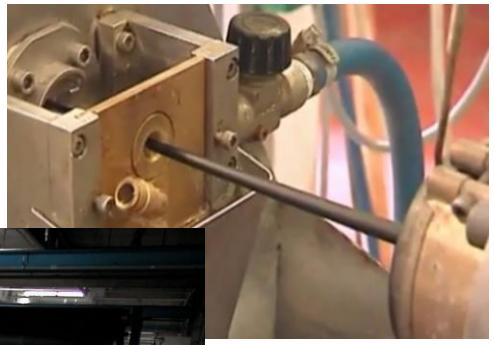
SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY TASK 54

Process Technologies – Continuous manufacturing

Extrusion of Sheets and Pipes

Hollow sheets

Pipes



Sheets / liners

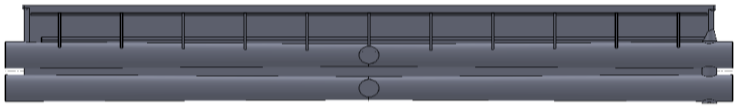
Complexity, investment, quantity

Process Technologies – Discontinuous manufacturing

Injection or Compression Moulding

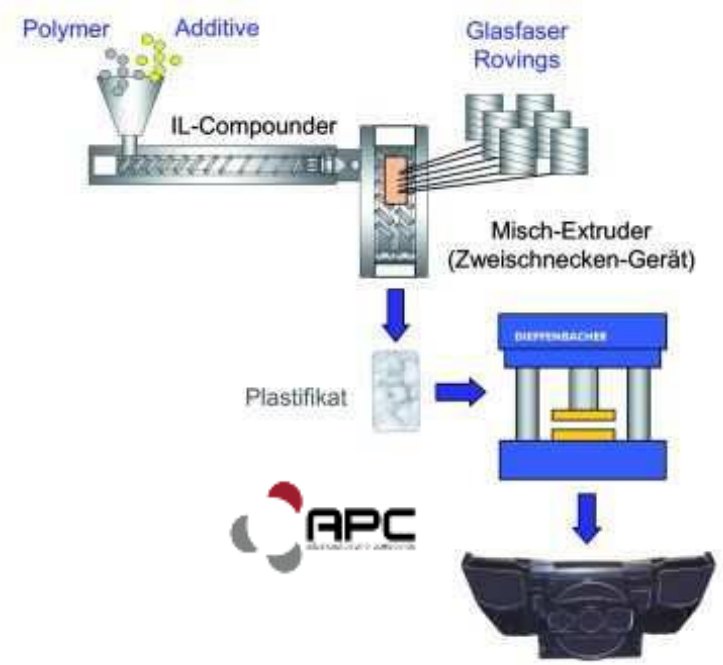
Injection moulding

aventa solar



MAGEN ECO-ENERGY

Compression moulding



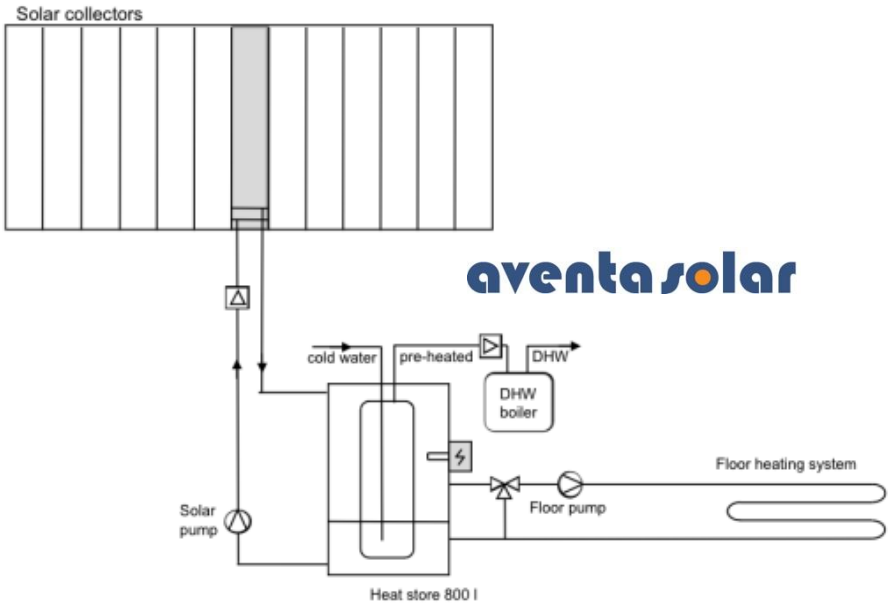
Complexity, investment, costs

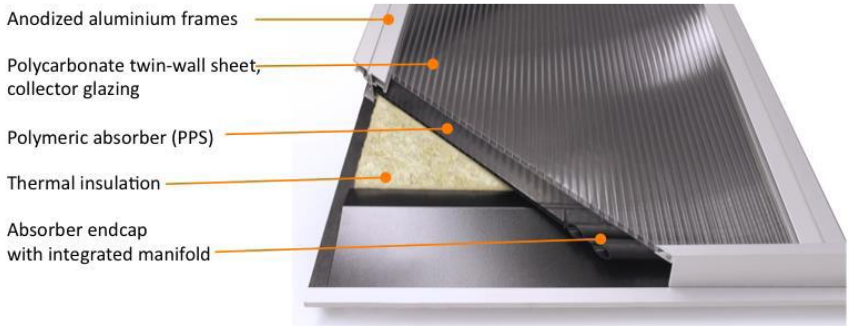
Complexity, investment, quantity

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY TASK 54

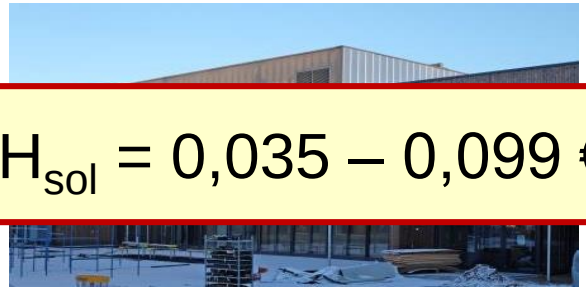
Solar-thermal systems – Hot Water & Space Heating

AVENTA SOLAR – PUMPED DRAINBACK SYSTEM





Rekstad, 2015 (AventaSolar collector system, Task39 Info sheet B16)



$$LCOH_{sol} = 0{,}035 – 0{,}099\ €/kWh$$

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY TASK 54

Solar-thermal systems – Domestic Hot Water

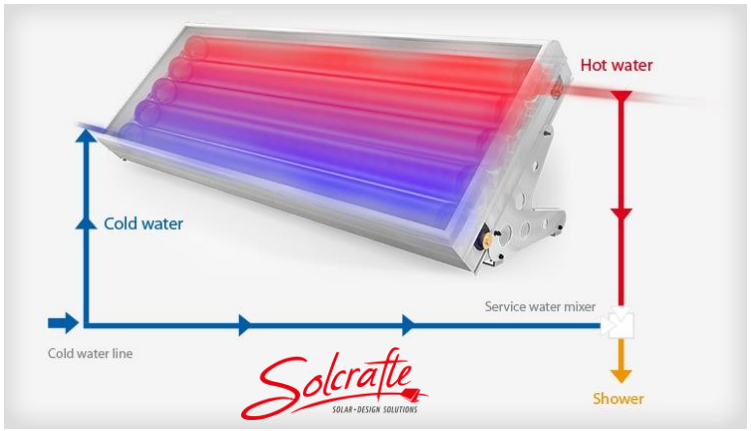
SUNLUMO – PUMPED "LOW PRESSURE" SYSTEM

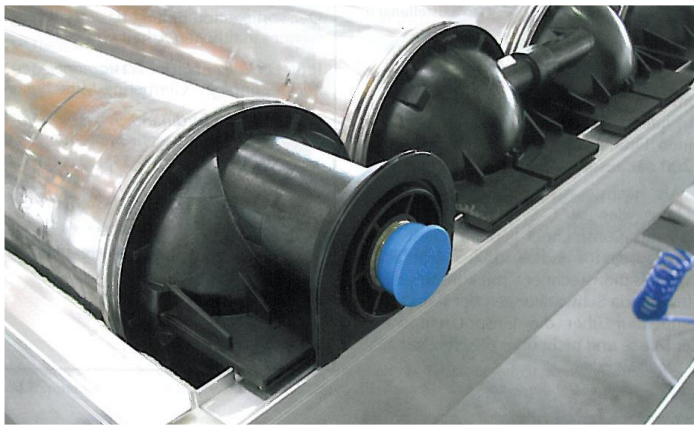
from 20 parts brass ….
to 10 parts plastic

$LCOH_{sol}$ = 0,01 – 0,03 €/kWh, if > 100.000 systems/year

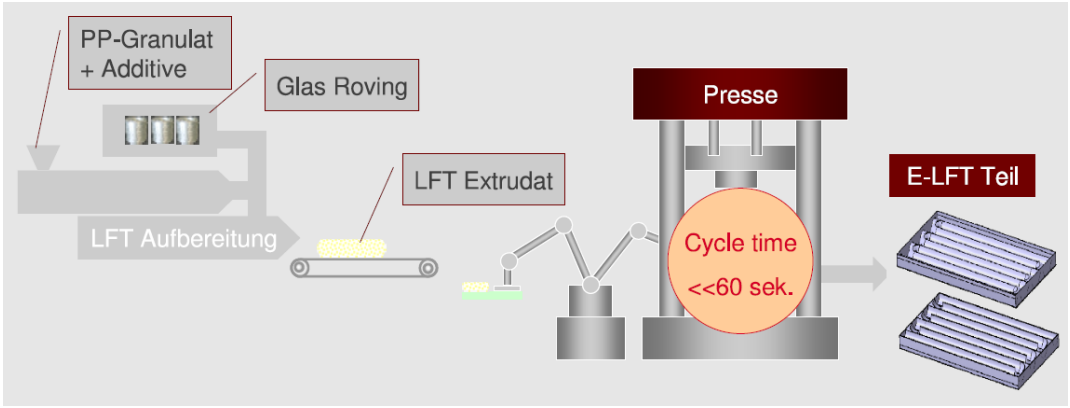
Solar-thermal systems – Domestic Hot Water

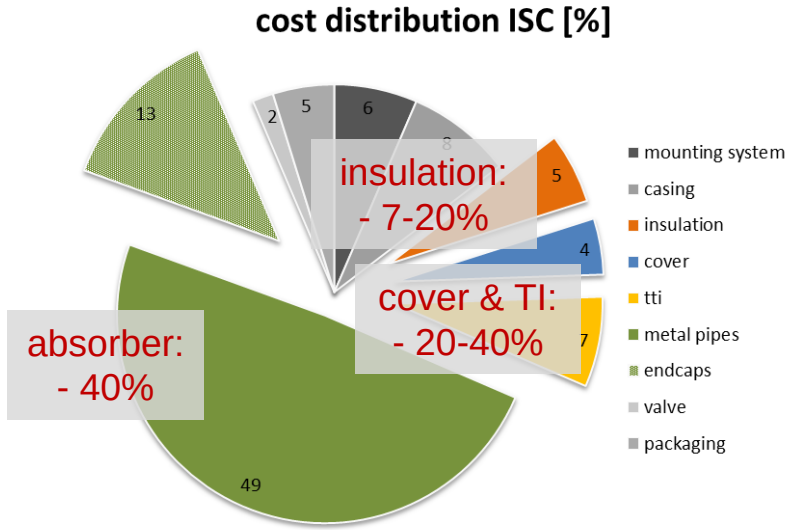
GreenOneTec – Integrated Storage Collector





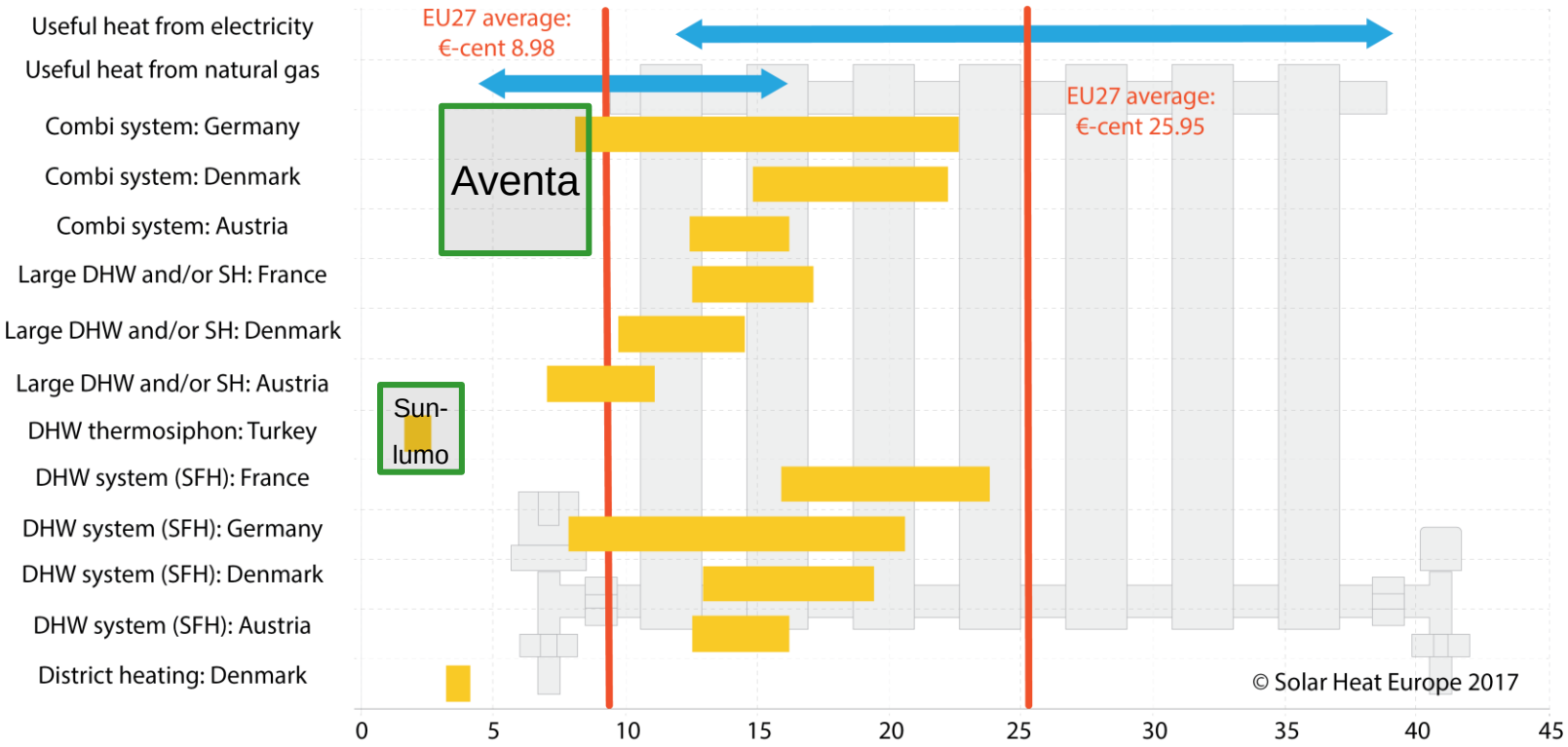
from > 100 parts/ …. to 7 parts/ISC





SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY TASK 54

Comparison of LCOH – Impact of new materials



Range of solar thermal heat costs for different types of solar thermal systems in different European regions (average costs over lifetime), compared with the range of costs for useful Useful heat considers the losses by converting natural gas and electricity into heat. The conversion efficiency of 85% for gas and 95% for electricity is assumed. Costs of natural gas and electricity of 2016, to domestic consumer.

Sources: solar heat systems: IEA-SHC & AEE-Intec; natural gas and electricity: Eurostat.

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY TASK 54