WP2.1 – Distribution medium, method

Thermochemical district networks:

Thermochemical district networks are a new technology for district networks that can provide heating and cooling in one **heat loss-free** multiservice network.

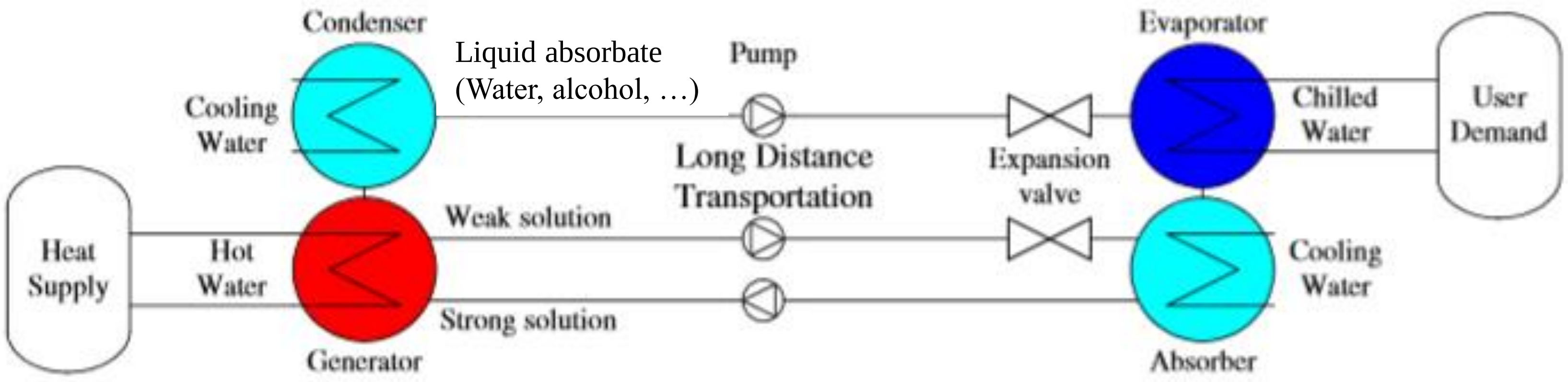
The innovation is the use of thermochemical fluids as transport medium (concentrated salt solutions).

The chemical potential is used to generate useful heat or cold from ambient heat at the place and time of demand.

Advantages: heat loss free

- Less investment (no insulation, smaller pipe diameters)
- Longer distances

Thermochemical district networks: Example schematics



Requirements for residential space heating:

- Evaporating with air as heat source preferably until -15°C
- Condensation below 30°C
- Fluid vapour pressures between 0.1 and 10 bar

Thermochemical fluids (water based)

Different groups of substances such as salts, alkalis, acids, organic compounds and ionic liquids can be used as absorbents.

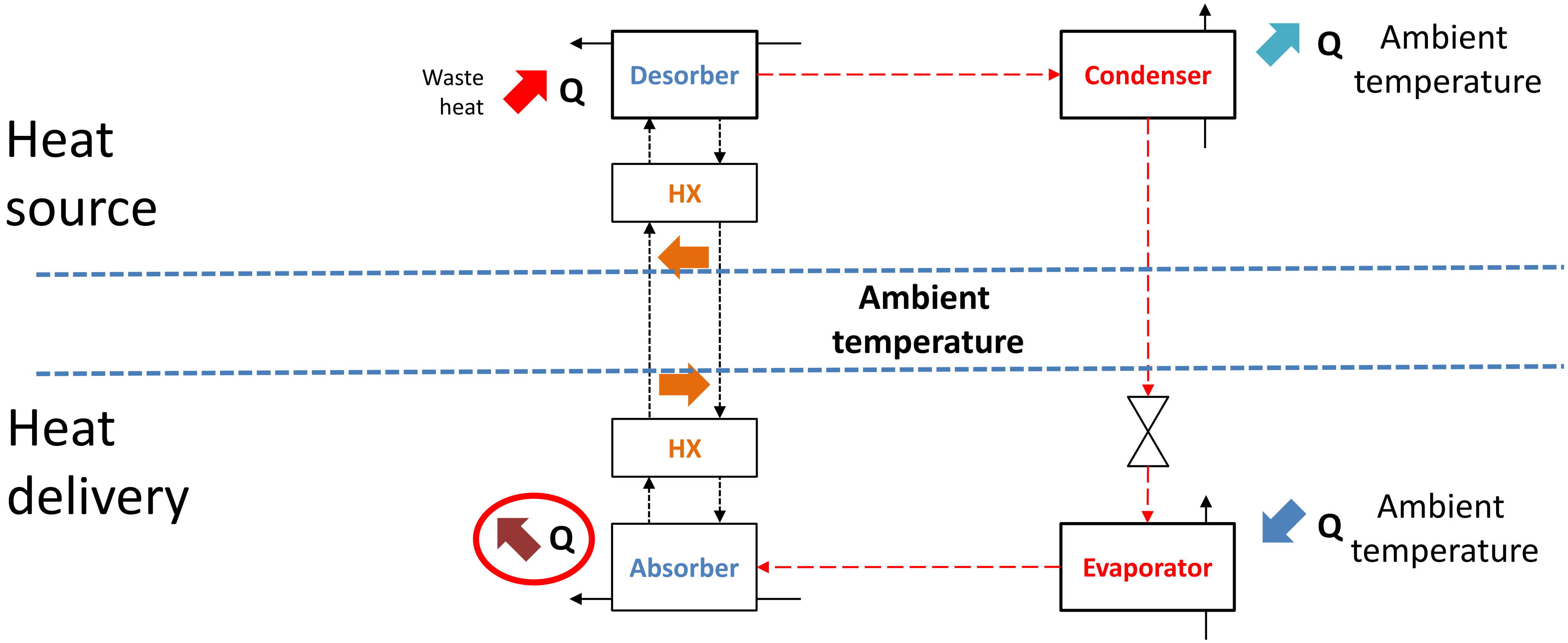
In addition to thermodynamic properties, the following criteria must be considered for the selection of the thermochemical fluid:

- Availability
- Price
- Environmental compatibility
- Recyclability
- Toxicity
- Chemical stability

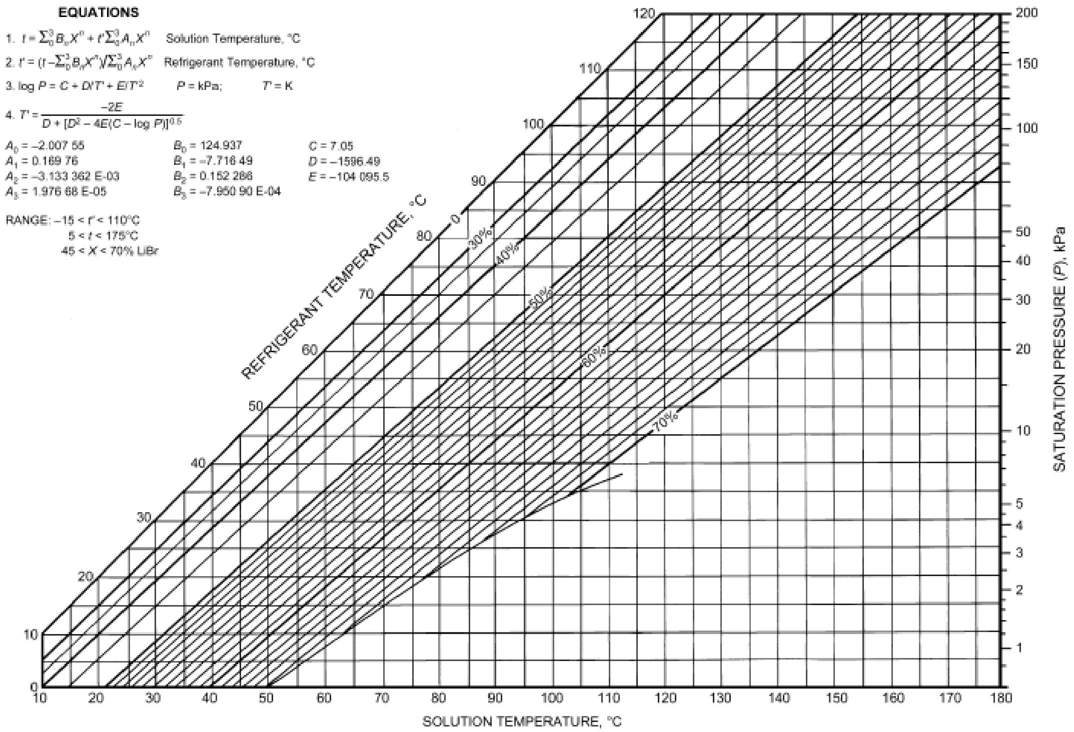
Thermochemical fluids (water based)

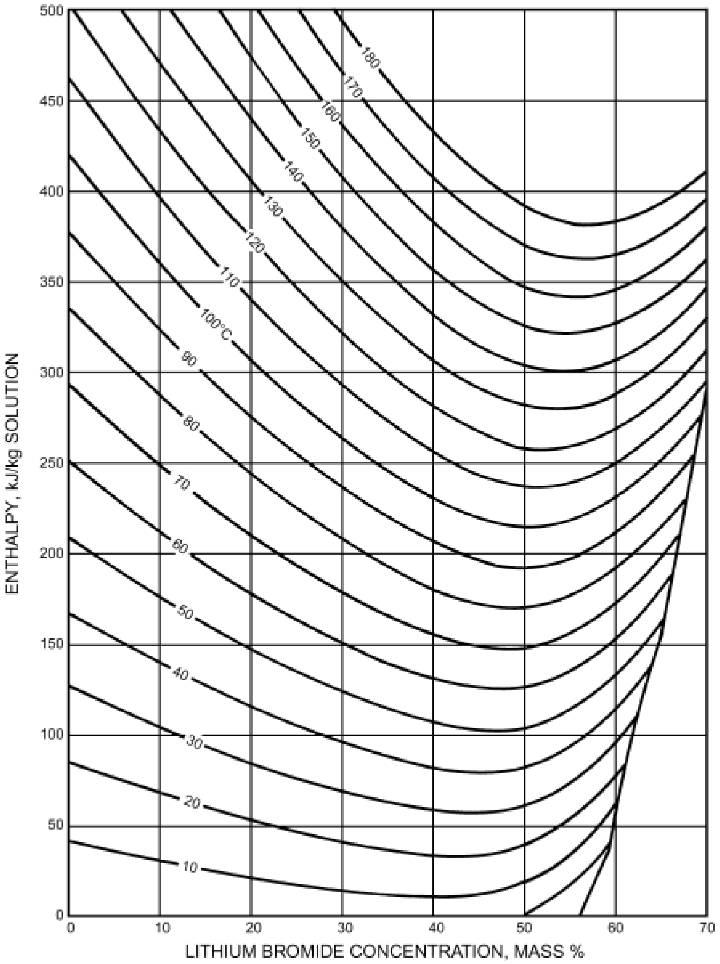
Desiccant	Comments
Lithium bromide (LiBr)	Common in absorption plants (chillers), but not suitable in thermochemical network due to the high price.
Lithium chloride (LiCl)	Common in dehumidification systems, but not suitable in thermochemical network due to the high price.
Calcium chloride ($CaCl_2$)	High efficiency.
Magnesium chloride ($MgCl_2$)	High efficiency.
Calcium nitrate $Ca(NO_3)_2$	Not corrosive. Low efficiency at low temperatures and high efficiency at high temperatures.
Sodium hydroxide (NaOH)	Very high efficiency. Not suitable in open processes.

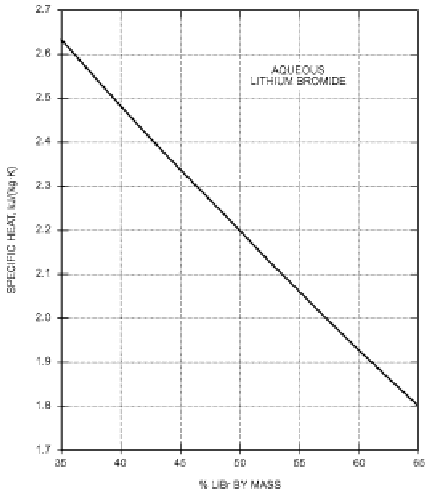
Example schematics



LiBr – H_2O properties (ASHRAE)







Example: LiBr – H_2O Matlab simulation

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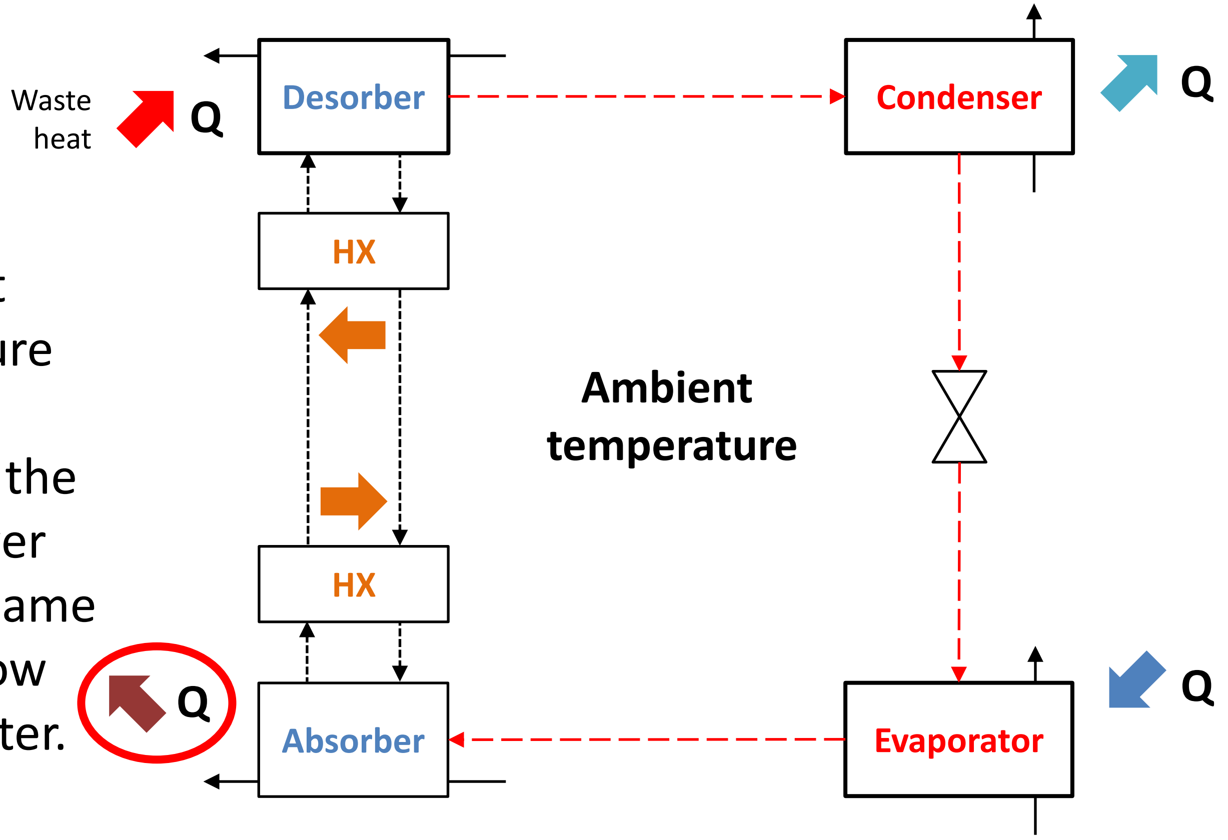
Tamb (C)	Tabs (C)	Tdes (C)	Qa	Abs/Des	ΔTeq H_2O
5	30	35	2320.23	0.82	53.53
5	30	40	2424.35	0.87	102.59
5	30	45	2476.95	0.89	145.02
5	40	45	2295.23	0.75	45.66
5	40	50	2460.69	0.82	90.62
5	40	55	2533.41	0.85	130.07
5	50	55	2249.75	0.67	38.52
5	50	60			
5	50	65			
10	30	35	2361.48	0.85	54.48
10	30	40	2449.61	0.89	103.66
10	30	45	2496.87	0.91	146.19
10	40	45	2343.00	0.78	46.61
10	40	50	2489.21	0.84	91.67
10	40	55	2555.51	0.87	131.21
10	50	55	2304.48	0.70	39.46
10	50	60	2510.10	0.79	80.02
10	50	65			
15	30	35	2402.74	0.88	55.43
15	30	40	2474.87	0.91	104.72
15	30	45	2516.80	0.92	147.36
15	40	45	2390.77	0.81	47.56
15	40	50	2517.73	0.87	92.72
15	40	55	2577.61	0.88	132.34
15	50	55	2359.22	0.73	40.39
15	50	60	2542.19	0.81	81.04
15	50	65	2614.03	0.84	116.70
15	60	65	2251.92	0.64	32.90
15	60	70	2502.09	0.75	68.26
15	60	75			

Equivalent temperature drop if delivering the same power from the same volume flow rate of water.



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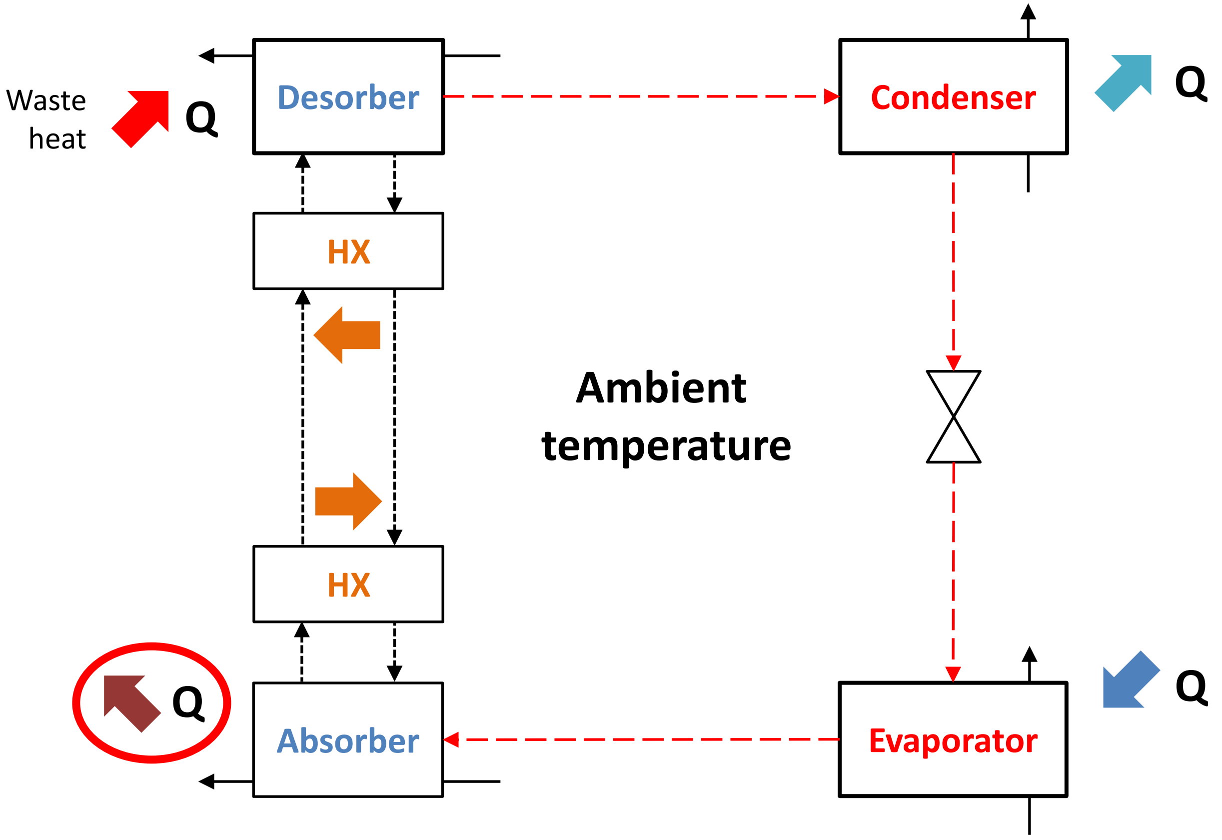
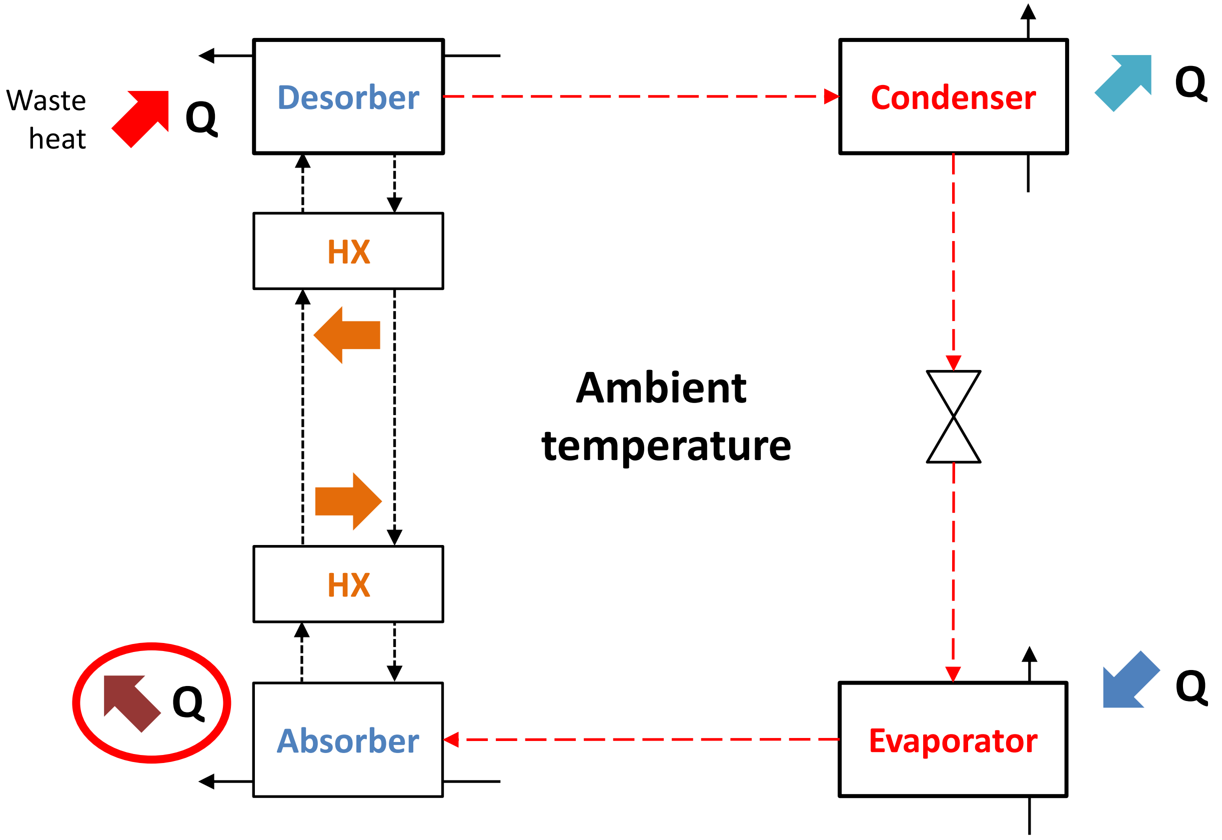
Example: LiI – H_2O Matlab simulation

Tamb (C)	Tabs (C)	Tdes (C)	Qa	Abs/Des	ΔTeq H_2O
5	30	35	2374.86	0.76	36.26
5	30	40			
5	30	45			
5	40	45			
5	40	50			
5	40	55			
5	50	55			
10	30	35	2371.01	0.81	42.34
10	30	40	2496.37	0.87	80.45
10	30	45	2561.14	0.88	111.94
10	40	45	2316.39	0.69	30.40
10	40	50			
10	40	55			
10	50	55			
10	50	60			
15	30	35	2365.35	0.87	50.32
15	30	40	2452.31	0.90	93.86
15	30	45	2502.99	0.91	129.75
15	40	45	2345.09	0.76	37.47
15	40	50	2506.35	0.83	71.72
15	40	55	2581.61	0.85	99.20
15	50	55	2221.56	0.62	24.49
15	50	60			
15	50	65			
15	60	65			
15	60	70			



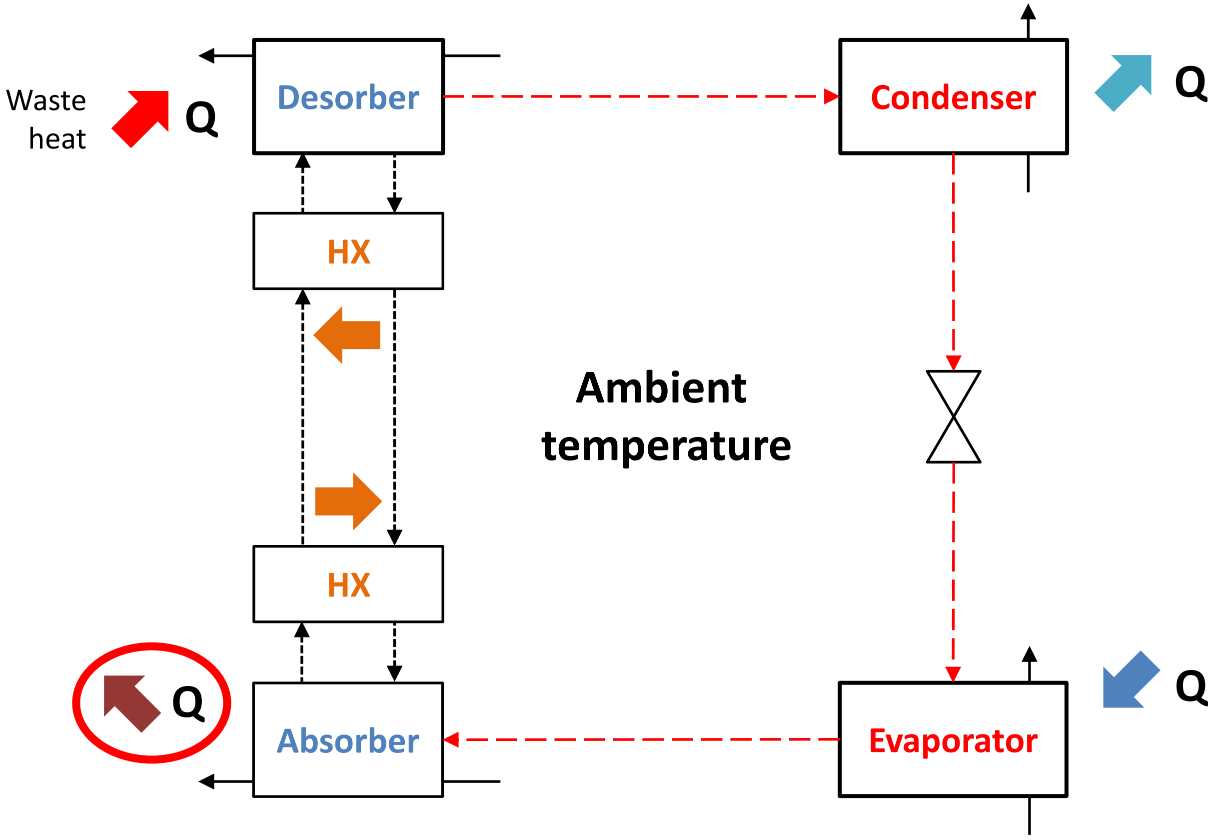
Example: LiCl – H_2O
Matlab simulation

Tamb (C)	Tabs (C)	Tdes (C)	Qa	Abs/Des	ΔTeq H_2O
5	30	35	2478.59	0.86	73.28
5	30	40			
5	30	45			
5	40	45			
5	40	50			
5	40	55			
5	50	55			
10	30	35	2469.72	0.89	79.20
10	30	40	2530.91	0.92	145.97
10	30	45			
10	40	45			
10	40	50			
10	40	55			
10	50	55			
10	50	60			
15	30	35	2465.44	0.91	87.46
15	30	40	2510.53	0.93	157.89
15	30	45	2535.55	0.94	214.80
15	40	45	2446.72	0.86	73.35
15	40	50	2523.65	0.90	137.31
15	40	55			
15	50	55			
15	50	60			
15	50	65			
15	60	65			
15	60	70			



Example: LiBr – CH_3OH Matlab simulation

Tamb (C)	Tabs (C)	Tdes (C)	Qa	Abs/Des	ΔTeq H_2O
5	30	35	1404.05	0.80	30.82
5	30	40	1480.14	0.86	56.58
5	30	45	1515.96	0.87	75.94
5	40	45	1352.37	0.68	19.37
5	40	50			
5	40	55			
5	50	55			
10	30	35	1397.47	0.83	32.50
10	30	40	1463.28	0.88	60.44
10	30	45	1497.18	0.89	82.15
10	40	45	1386.81	0.73	22.97
10	40	50			
10	40	55			
10	50	55			
10	50	60			
15	30	35	1384.81	0.86	32.56
15	30	40	1441.57	0.90	62.02
15	30	45	1473.73	0.91	85.93
15	40	45	1399.94	0.78	26.24
15	40	50	1482.88	0.84	48.84
15	40	55			
15	50	55			
15	50	60			
15	50	65			
15	60	65			
15	60	70			



Pairs comparison

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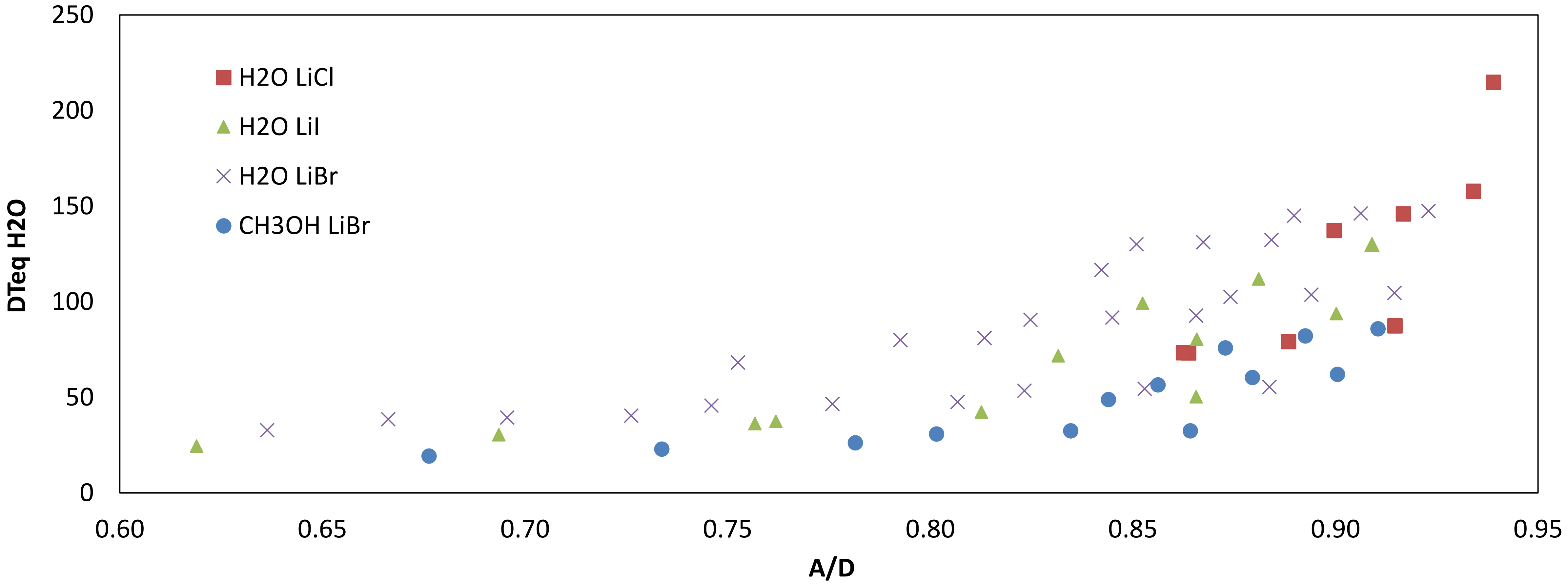

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Thank you