"ICEPIT"

Simulation program for vertically stratified storage bed for heat and cold storage

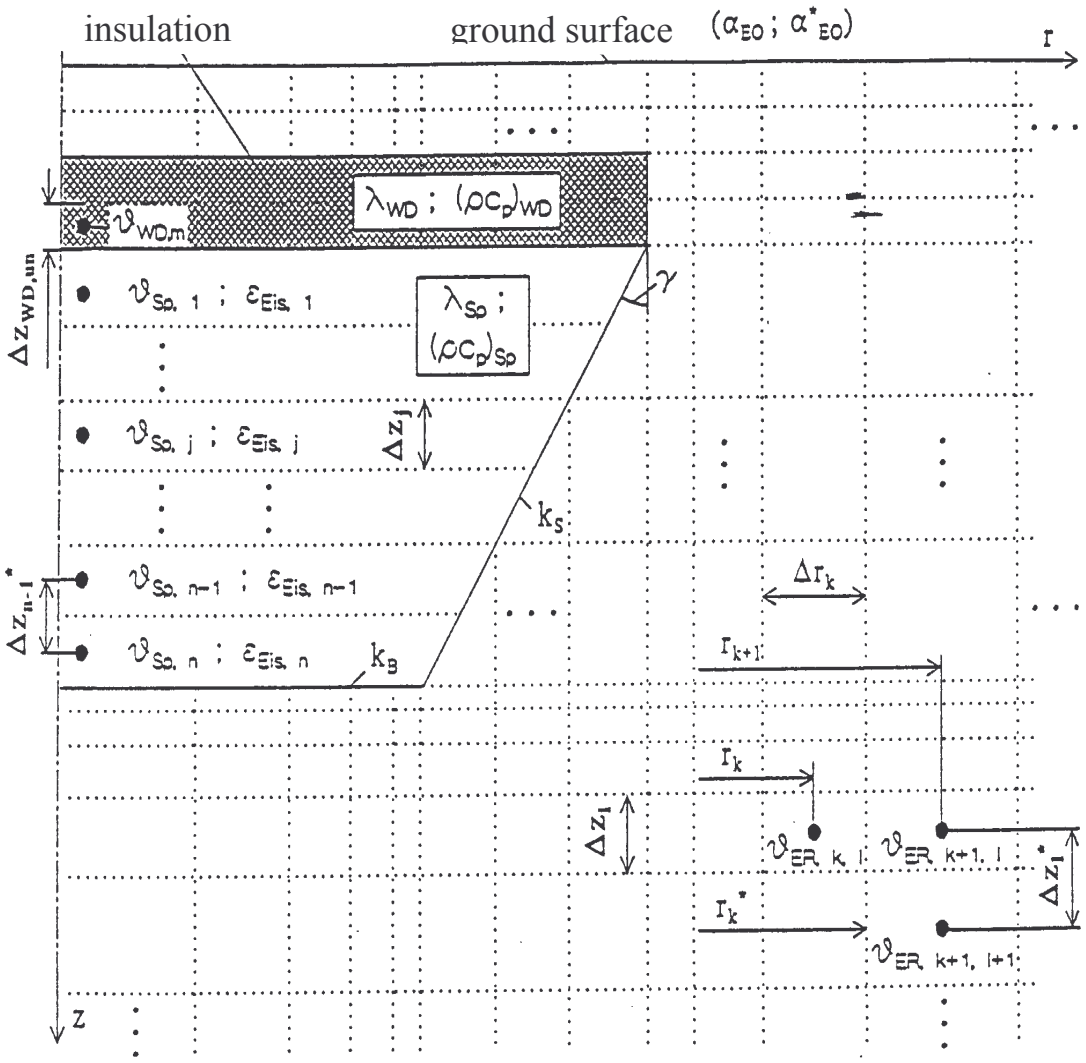

figure 1: grid of "ICEPIT" storage

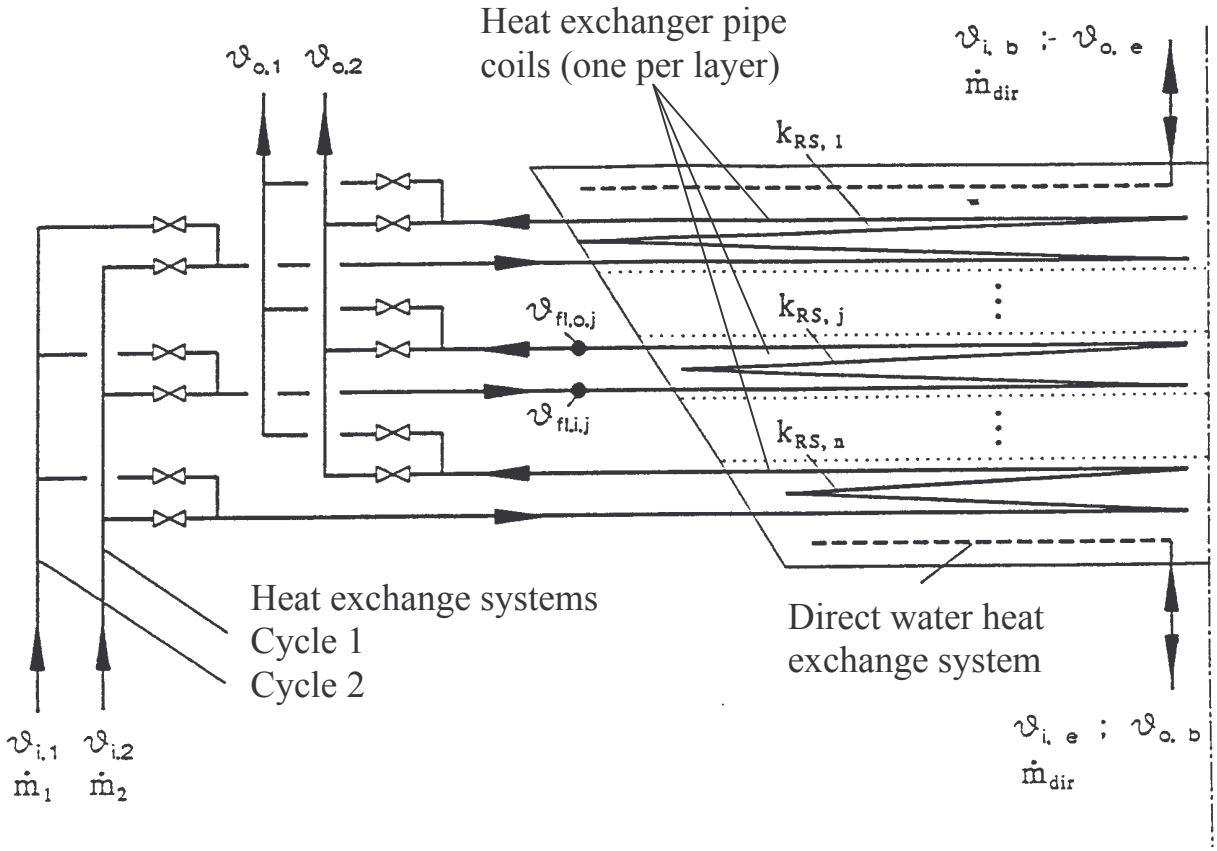

figure 2: charge and discharge of "ICEPIT" storage

Parameter	variable	discription	unit
1	DTOP	Upper diameter of storage bed	[m]
2	DBOT	Lower diameter of storage bed	[m]
3	HLAY(1)	Thickness of top storage layer	[m]
.	.		
.	.		
N+2	HLAY(N)	Thickness of nth (from top) storage layer	[m]
N+3	DEEPST	Depth of top of storage bed below ground suface (max. 3 m)	[m]
N+4	HINS	Thickness of thermal insulation on top of storage bed	[m]
N+5	ROCPST	Volumetric thermal heat capacity of storage material	[kJ/m³K]
N+6	LAMBST	Heat conductivity of storage material	[kJ/hmK]
N+7	POROST	Cavity portion of storage material (water volume/total volume, with water storage= 1)	[-]
N+8	PERMST	Permeability of storage material (gravel: 10^{-7} m², water: (π DACOIL)²)	[m²]
N+9	KSIDE	Heat transfer coefficient at storage bed side wall	[kJ/hm²K]
N+10	KBOT	Heat transfer coefficient at storage bed bottom	[kJ/hm²K]
N+11	ROCPTI	Volumetric heat capacity of thermal insulation at top of storage bed	[kJ/m³K]
N+12	LAMBTI	Heat conductivity of the thermal insulation at storage cover	[kJ/hmK]
N+13	ROCPGR	Volumetric thermal capacity of local soil	[kJ/m³K]
N+14	LAMBGR	Heat conductivity of local soil	[kJ/hmK]
N+15	ALFAGS	Heat transmission coefficient of ground surface	[kJ/hm²K]
N+16	ABKOGS	Absorption factor of ground surface	[-]
N+17	CPFLUI	Specific thermal capacity of fluid in heat exchanger pipe coils	[kJ/kgK]
N+18	LAMBIC	Heat conductivity of frozen storage material (ice or gravel/ice)	[kJ/hmK]
N+19	DACOIL	Outside diameter of heat exchanger pipe coils	[m]
N+20	DICOIL	internal diameter of the heat exchanger pipe coils	[m]
N+21	ALFICO	internal heat transmission coefficient of heat exchanger pipe coils	[kJ/hm²K]

N+22	LAMBCO	Heat conductivity of pipe coil	[kJ/hmK]
N+23	LCOIL(1)	Length of 1st heat exchanger pipe coil	[m]
2*N+22	LCOIL(N)	Length of nth heat exchanger pipe coil	[m]
2*N+23	DEGICE(1)	Initial volumetric ice portion of	[-]
.	.	1st storage layer	
3*N+22	DEGICE(N)	Initial volumetric ice portion of nth storage layer	[-]
3*N+23	TGRSRT	Initial subsoil temperature, given a homogeneous temperature distribution at program start	[°C]
3*N+24	TGRINF	Subsoil temperature at outside edge of simulated area	[°C]
3*N+25	POTGRD	Option for frequency of output of temperature distribution in the soil: 0: none, 1: annually, 2: monthly, 3: weekly, 4: daily, 5: hourly	[-]
3*N+26	LUPRTG	Number of the output unit for file with subsoil temperatures	[-]

Input	**variable**	**discription**	**unit**
1	TINCO1	Inlet temperature of pipe system cycle 1	[°C]
2	MINCO1	Mass flow of pipe system cycle 1	[kg/h]
3	TINCO2	Inlet temperature of pipe csystem cycle 2	[°C]
4	MINCO2	Mass flow of pipe system cycle 2	[kg/h]
5	TINDIR	Inlet temperature of direct water heat exchange system	[°C]
6	MINDIR	Mass flow, direct water heat exchange system (> 0: downward, < 0: upward)	[kg/h]
7	TAMB	Ambient temperature	[°C]
8	EGLOBH	Global irradiance on horizontal surface	[kJ/hm²]

9	GAMMA1(1)	Valve position for coupling of the tubing	[-]
.	.	queue 1 at coil of pipe circle 1 (GAMMA1(1)	
.	.	= 1: openly)	
N + 8	GAMMA1(N)	Valve position for coupling of the tubing queue N at coil of pipe circle 1	[-]
N + 9	GAMMA2(1)	Valve position for coupling of the tubing	[-]
.	.	queue 1 at coil of pipe circle 2	
.	.		
2*N + 8	GAMMA2(N)	Valve position for coupling of the tubing queue N at coil of pipe circle 2	[-]

Please note: Each tube coil can only be coupled to one circuit!

Output quantity	**variable**	**discription**	**unit**
1	TOUCO1	Outlet temperature coil of pipe circle 1	[°C]
2	MOUCO1	Mass flow coil of pipe circle 1	[kg/h]
3	TOUCO2	Outlet temperature coil of pipe circle 2	[°C]
4	MOUCO2	Mass flow coil of pipe circle 2	[kg/h]
5	TOUDIR	Outlet temperature direct water out exchange system	[°C]
6	MOUDIR	Mass flow direct water exchange system	[kg/h]
7	QLOST	Calorific loss stream by storage cover	[kJ/h]
8	QLOSS	Calorific loss stream by storage side panel	[kJ/h]
9	QLOSB	Calorific loss stream by storage soil	[kJ/h]
10	QLOSTT	Calorific loss stream entirely	[kJ/h]
11	QSTTOT	internal energy in the storage (QSTTOT = 0 and ice portion ice = 0)	[kJ]
12	QTCO1	Heat flow coil of pipe circle 1	[kJ/h]
13	QTCO2	Heat flow coil of pipe circle 2	[kJ/h]
14	QTDIR	Heat flow direct water exchange system	[kJ/h]
15	TSTAVG	middle storage temperature	[°C]
16	TSTA(1)	Temperature 1. Storage layer	[°C]
.	.		
.	.		
N + 15	TSTA(N)	Temperature nth storage layer	[°C]

N + 16	DEGICE(1)	Volumetric ice portion of 1.	[-]
.	.	Storage layer	
.	.		
2*N + 15	DEGICE(N)	Volumetric ice portion nth	[-]
		storage layer	
2*N + 16	KARS(1)	Heat transfer ability of the	[kJ/hK]
.	.	1. Tubing queue	
.	.		
3*N + 15	KARS(N)	Heat transfer ability of the nth	[kJ/hK]
		tubing queue	
3*N + 16	ALFAA(1)	outside heat transmission coefficient·? Outside	[kJ/hm²K]
.	.	surface (?a·Aa) of the 1. Coil of pipe	
.	.		
4*N + 15	ALFAA(N)	outside heat transmission coefficient? Outside	[kJ/hm²K]
		surface (?a·Aa) of the nth coil of pipe)	

Abhängige Variable (Derivative)	**variable**	**discription**	**unit**
1	TSTA(1)	Temperature 1. Storage layer	[°C]
.	.		
.	.		
N	TSTA(N)	Temperature of the nth. Storage layer	[°C]

Number of independent variables (Derivatives) = number of memory layers: n ≤ 20; n must be an even number,