Dynamic simulations of solar combisystems integrating a seasonal sorption storage: Influence of the combisystem configuration

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Objectives: To **Study the influence of solar combisystem configuration on the global performances. To show the impact of the seasonal storage on the combisystems sizing.**

Methodology

Two combisystems configurations are compared, with and without seasonal thermochemical (TC) storage. The analysis is conducted in dynamic simulation, using TRNSYS 17.

- **Configuration A** : 2 storage tanks, 1 for space heating (SH) and 1 for domestic hot water (DHW);
- **Configuration B** : only 1 tank with an external heat exchanger for the production of the DHW.

The influence of the following parameters is studied:

- Solar collectors area;
- Tanks volume;
- Adsorbent mass used for the seasonal TC storage.

Results

Best cases are computed for each collectors area **with and without seasonal TC storage**.

The *best case* is defined as the case allowing to reach **at least the maximum value computed for Fsav,TOT minus 1 %**, with the smallest adsorbent mass (if used) and the smallest sensible storage volume (among those with the smallest adsorbent mass).

Performance Indicator

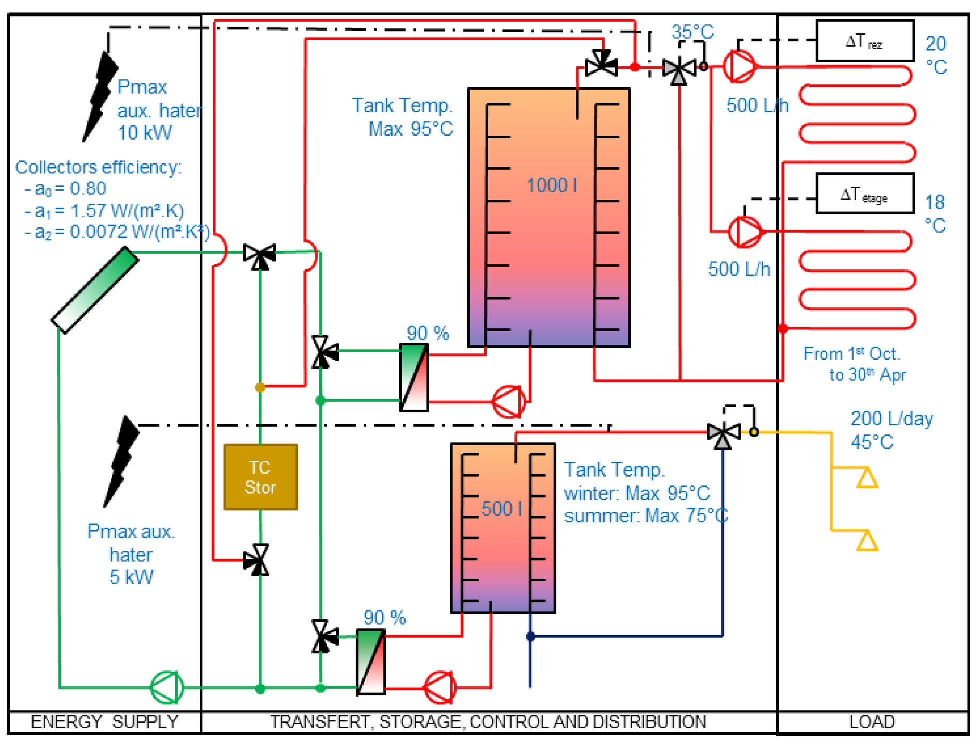
The fractional thermal energy savings[1]:

$$F_{sav,therm} = 1 - \frac{E_{auxiliary}}{E_{ref}} = 1 - \frac{\frac{Q_{el,heater}}{\eta_{el,heater}}}{\frac{Q_{boiler,ref}}{\eta_{boiler,ref}}}$$

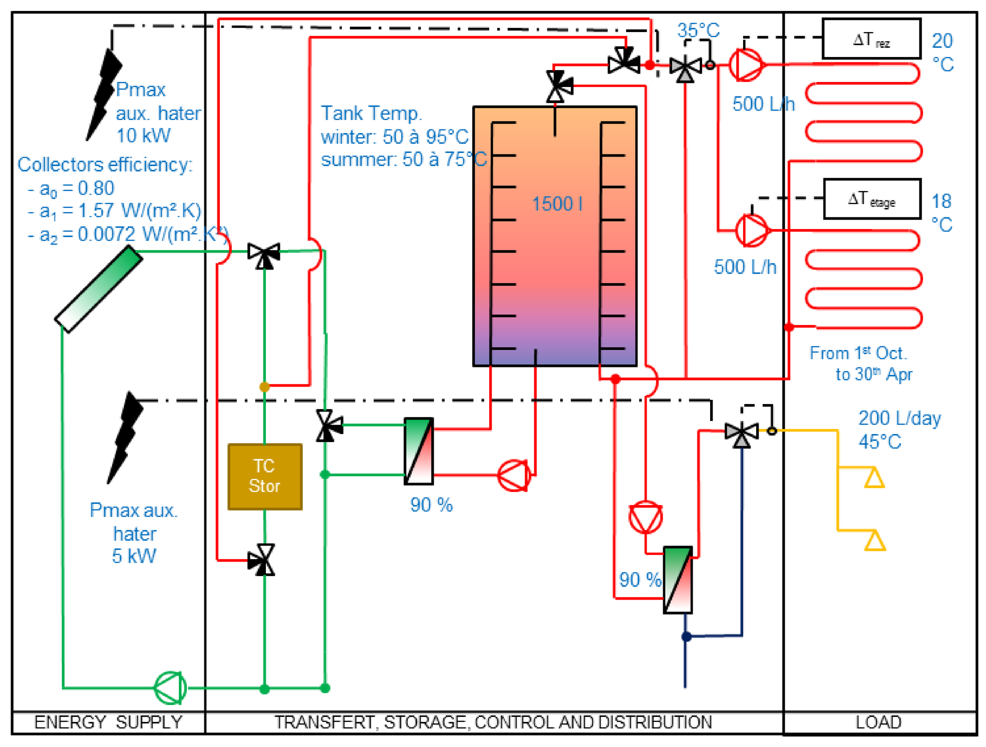
$F_{sav,therm,TOT}$ computes the global thermal needs (DHW and SH).

[1] Reference: *IEA-SHC Task 26 (Letz 2002)*

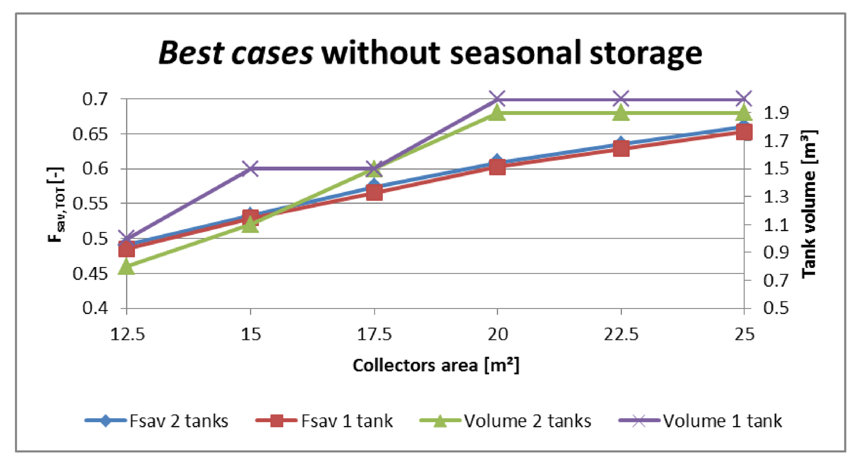
Configuration A



Configuration B

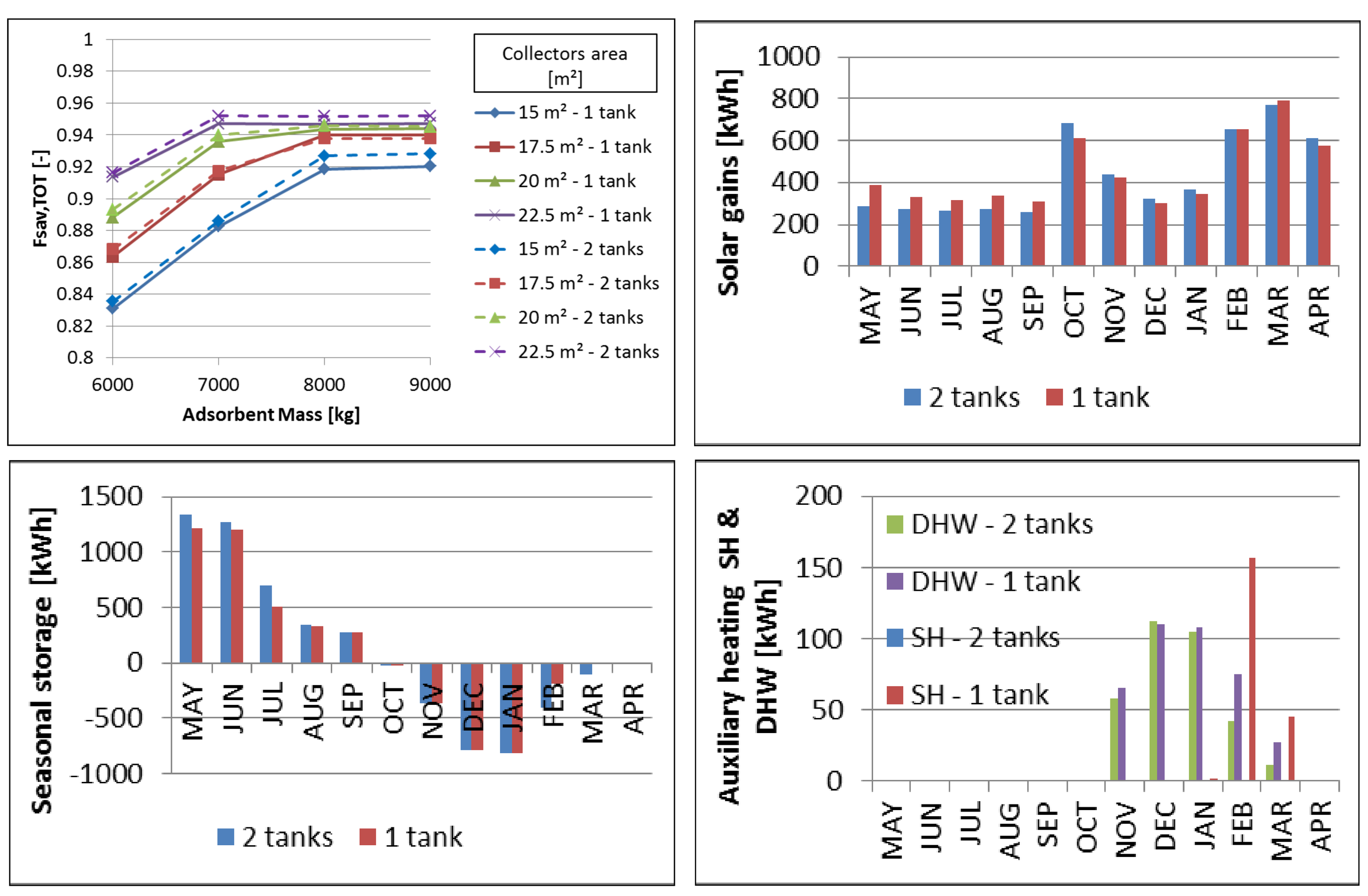


Without TC storage



- Without TC storage, both configurations reach **almost the same performances**.
- Small advantage (<1 %) for the system with 2 tanks.

Case study: 1,5 m³ sensible storage, 22,5 m² solar collectors and 7000 kg adsorbent

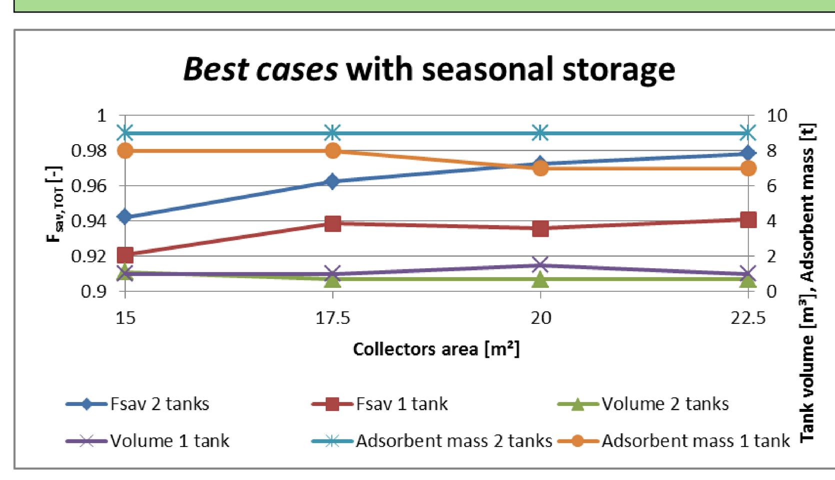


For 1,5 m³ sensible storage: in most case, the performances are slightly better (around 1%) with 2 tanks than with 1.

The single tank:

- Is too large for summer operation which reduces solar energy available for the seasonal storage;
- Gets lower solar gains in winter because it is hotter;
- Is subject to stratification reduction when the TC storage is "empty" → this increases consumption for DHW production.

With TC storage



With TC storage, **the advantage of the configuration A is greater** (up to 4 %) .

- For an equivalent mass of adsorbent, results are better (up to 2 %) for configuration A.
- The **TC storage** allows **saving between 30 and 40 %** for identical areas of collectors.
- The configuration of the system has little influence on the necessary volume for the sensible storage.
- The **sizing of the storage tank won't be the same** if some seasonal storage occurs.

Conclusion

Two main conclusions are drawn. **Firstly**, the results show similar performances for both configurations (with and without TC storage). The small advantage computed for the configuration with two tanks wasn't expected. We hoped to increase the system performance by reducing thermal losses through the envelope of the tank, with a single tank. Nevertheless, this configuration (B) allows reducing the bulk of the system and the investment cost. Some modifications may also be investigated to increase its performance. **Secondly**, if **the sizing of the sensible storage** seems to be very close for both configuration, some **differences appear if we compare the system with and without seasonal storage**. If the storage reactor is used, the sensible storage has to be around 1 m³ and does not increase with the collectors area as for the system without TC storage.

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