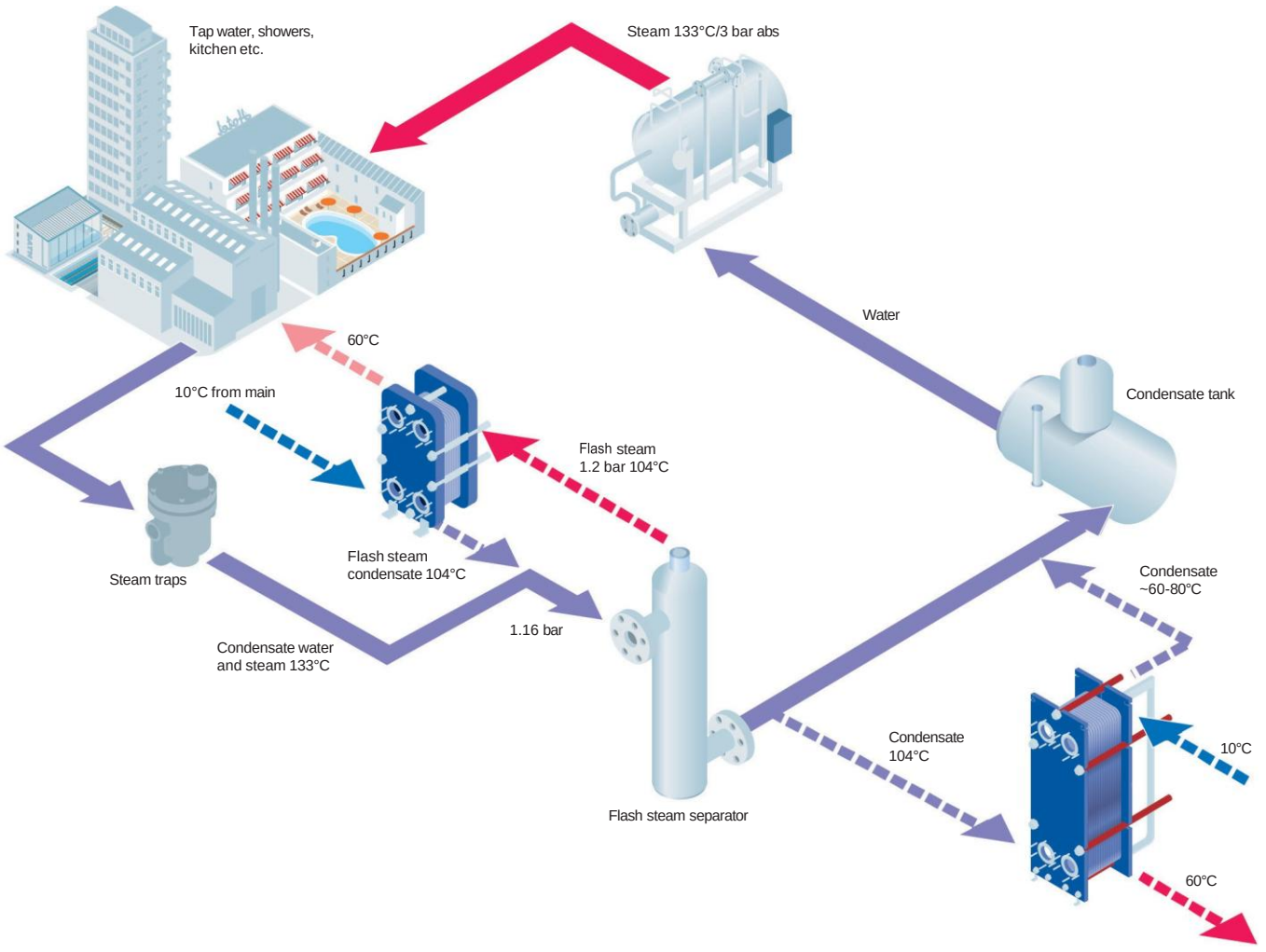
Heat recovery from waste flash steam

Steam is found in abundance as a primary heating media in many manufacturing industries, hotels, hospitals, food processing, and pharmaceutical industries. The popularity of steam can be attributed to its high calorific value per ton, economic benefits and not requiring pumping around long distances in large plants. Some of the challenges in steam lie in its regulation, control, and condensate management.

Flash steam is undesired in a perfect steam system. Ideally, 100% of the produced steam vapour should condense at the usage points, and good steam traps should not permit flash steam to enter the condensate tank. Steam systems are designed to minimize heat losses with insulation on piping and control valves and release of flash steam to the atmosphere, which is a massive waste of valuable energy if not recovered.

The below diagram shows a simple steam cycle where the steam generated at the boiler, used for various processes at 3 bar or 133°C releasing its heat by condensation and the condensate returning to the condensate tank. Uncondensed steam travelling with the condensate usually released to the atmosphere as flash steam. This is undesired as steam not returned as condensate needs to be refilled with costly treated makeup water. For heat recovery, a gasketed plate heat exchanger (GPHE) installed with a simple separation vessel containing a conic rise inhibitor.

Heat recovered from flash steam can produce hot water for plant cleaning, bathing facilities, heating offices, and production facilities, returned to the production process, preheat makeup water or sold to surrounding district heating networks.



Energy Hunter – Utilities

Heat recovery equipment

Steam is a highly efficient heating media; hence the over efficiency that is offered by most widespread liquid to liquid application plate heat exchangers, is not right. Liquid to liquid units are designed with efficient plate design, a tall height, narrow channel gap, and a narrow width – forcing a small connection diameter. This will result in oversized units with high-pressure drops that can lead to stalling and mechanical plate fatigue. Hence, steam requires precisely the opposite geometry of the plate, being short and fat; allowing a larger diameter connection and with wide channel gaps.

The Alfa Laval TS6-M and TS20-M are designed for steam and are perfect for heat recovery from flash steam with minimum steam pressure drop, as flash steam is generally at atmospheric pressures.

TS6-M

TS20-M

The technology to efficiently recover heat from flash steam are best suited with gasketed plate type heat exchangers, especially designed for steam. The proportion of condensate return depends on the industry and process. The table below shows the proportion of condensate return for different applications:

Steam application	% condensate return
Autoclave heating	0%
Jacket heating	90-100%
CIP	90-100%

In flash steam heat recovery, the vapour collected at the separator before the condensate tank (can be a concrete in ground pit) is connected to the top inlet of the GPHE and can condense with a minimum pressure drop. On the other side, cold water entering at the bottom connection will be heated by the condensing flash steam.

Calculation of savings per ton of condensed flash steam

- Flash steam at 103°C / 1.1 bar atmosphere.
- Savings 8 hours/day 20 days/month.
- Cost of heating with natural gas 0.10 euro/kWh.
- Investment other than GPHE is 10,000 euro.
- Return on Investment (ROI) based on GPHE exchanger product pricelist.
- (TS6M FG Alloy 316 0.6 mm EPDM Clip-On DN65 flanged connections.)

Radiator water or process water heating with recovered flash steam

Amount of flash steam recovered (kg/hr)	Amount of water (kg/hr) heated*	Energy savings (kW)	Alfa Laval model	No. of plates	Savings in euro per month	Approximate Return on Investment (ROI months)
100	2,730	63.6	TS6-M FG	8	1,018	13.2
200	5,464	126.8	TS6-M FG	12	2,029	6.8
300	8,216	190.7	TS6-M FG	16	3,051	4.6
500	13,693	317.9	TS6-M FG	22	5,086	2.9
750	20,609	478.4	TS6-M FG	32	7,654	2.1
1,000	27,485	638.0	TS6-M FG	42	10,208	1.7

* 60°C → 80°C, ΔT 20°C

Tap water heating with recovered flash steam

Amount of flash steam recovered (kg/hr)	Amount of water (kg/hr) heated*	Energy savings (kW)	Alfa Laval model	No. of plates	Savings in euro per month	Approximate Return on Investment (ROI months)
100	1,100	63.9	TS6-M FG	8	1,022	13.1
200	2,192	127.3	TS6-M FG	10	2,037	6.7
300	3,307	192.1	TS6-M FG	14	3,074	4.5
500	5,521	320.7	TS6-M FG	20	5,131	2.8
750	8,285	481.2	TS6-M FG	28	7,699	2.0
1,000	11,056	642.2	TS6-M FG	34	10,275	1.6

* 10°C → 60°C, ΔT 50°C

▼ PRACTICAL TIPS

Stalling can be reduced by minimizing oversurfacing with a flow by-pass method, condensate level control or installation of a vacuum breaker.

Alfa Laval reserves the right to change specifications without prior notification.