

Recovery Boiler



Process description

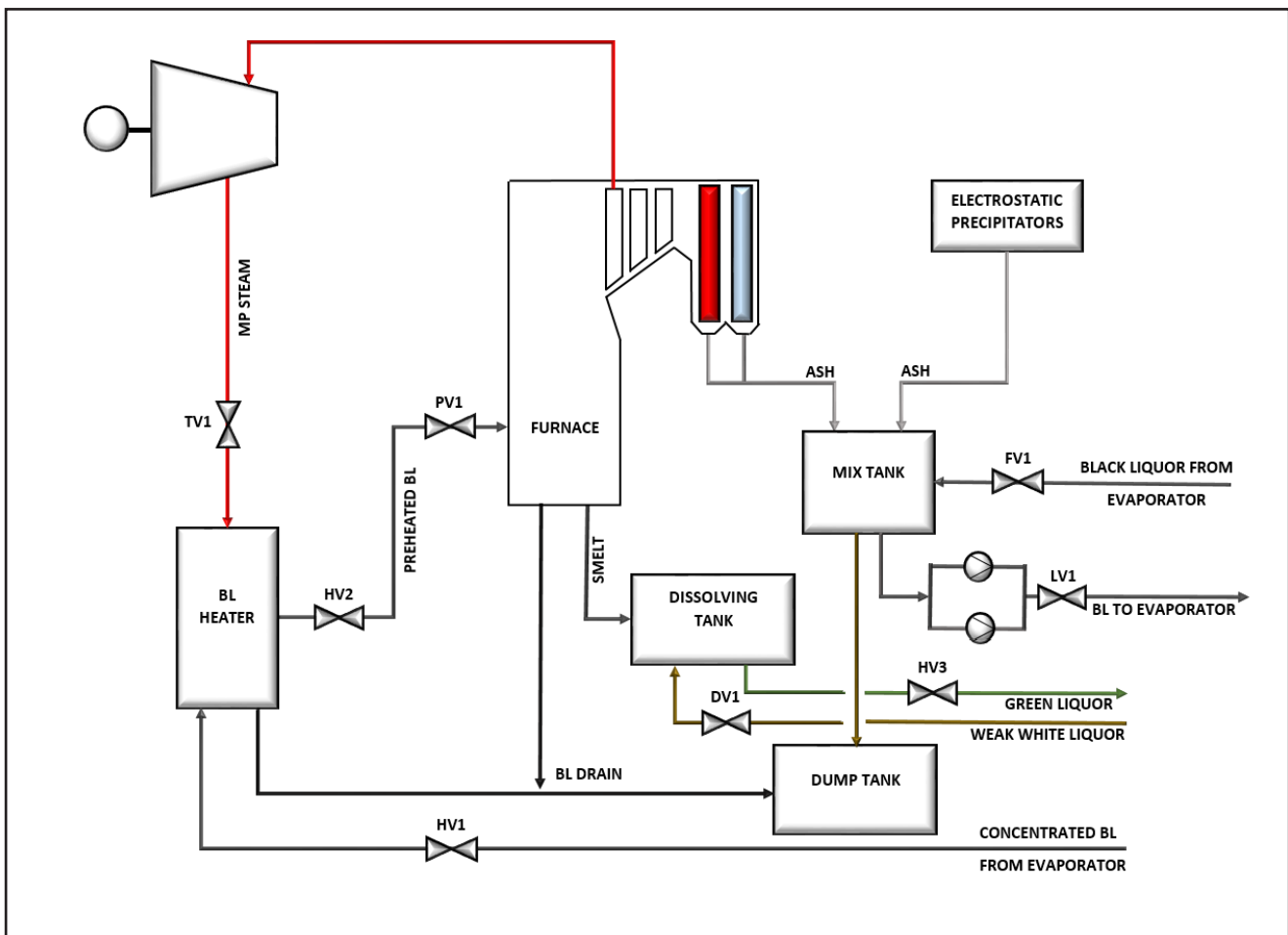
A Recovery boiler has two different functions, chemical recovery and the production of electricity and steam. These two processes are separated from each other. The turbine is not a part of recovery boiler but its operation is included here. Black liquor is separated from pulp during the post-cook washing stages. The liquor is pumped from

the washers to the evaporation plant for the removal of excess water and then onwards to the recovery boiler. Concentrated black liquor contains organic dissolved wood residue in addition of cooking chemicals. The purpose of chemical recovery is preparation of white liquor from cooking chemicals for the sulfate cook.

Combustion of black liquor

Black liquor has high viscosity and it contains salts, organic compounds and almost all of the chemicals added in the cooking process. Before combustion, black liquor is mixed with collected fly ash from precipitators, economizers and boiler banks in a mixing tank. High solids content increases reduction degree and steam production. The mixture is pumped back to the evaporator. Concentrated black liquor is preheated to 100-200 °C in a liquor heater. Preheated black liquor is fed into a furnace through several black liquor guns located in the furnace walls.

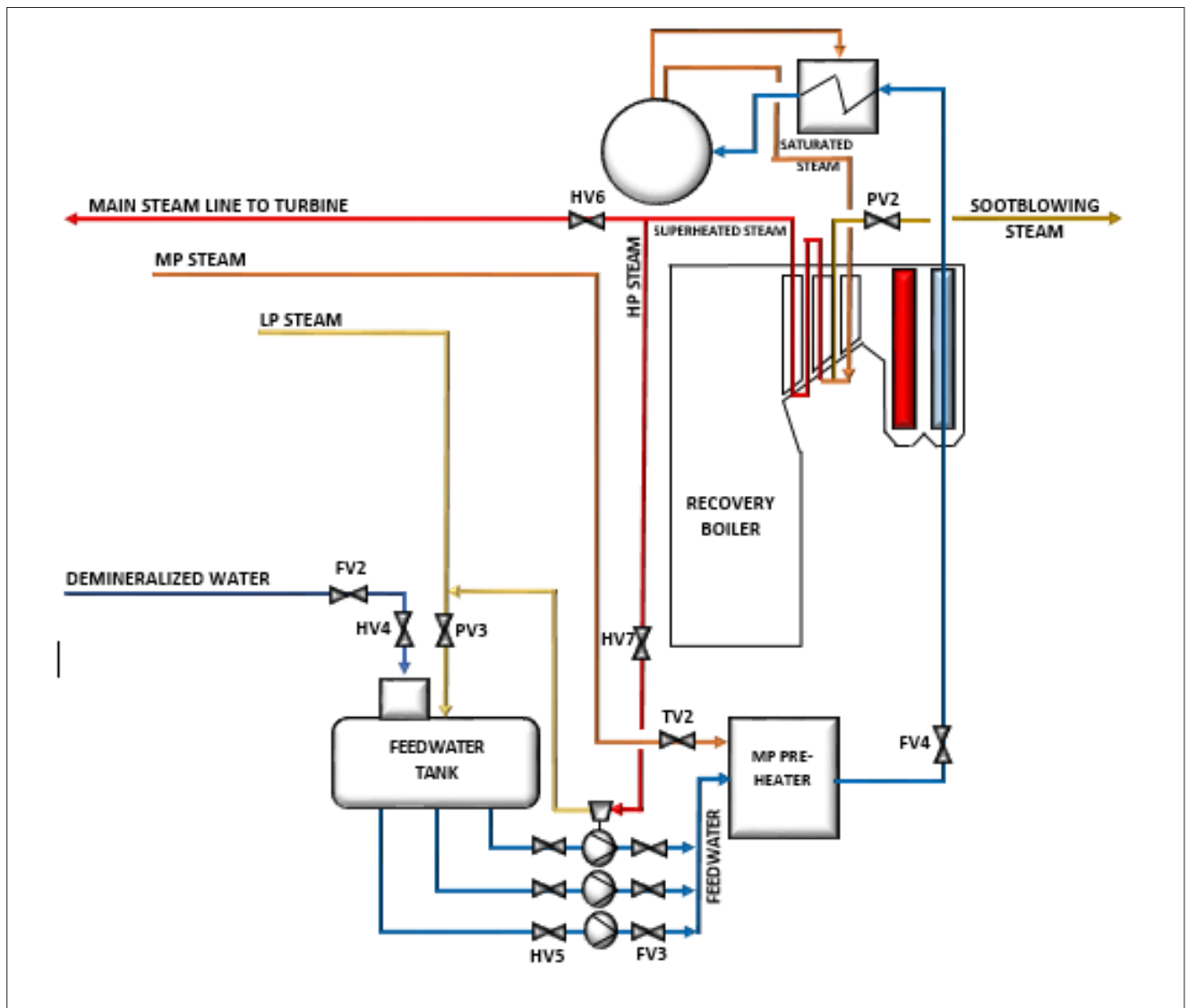
Because the liquor contains high levels of sulfur the combustion needs to be controlled to avoid production of sulfur dioxide. Combustion of organic compounds produces heat and part of inorganic matter is recovered as smelt from the bottom of the recovery boiler. The smelt (800-1000 °C) which contains sodium carbonate and sodium sulfate is mixed with weak white liquor at dissolving tank to form green liquor. The green liquor is directed into a causticizing plant to be processed further into white liquor. Black liquor drains are directed from mix tank, liquor heater and furnace to a dump tank.



Water and steam system

The water and steam system of the recovery boiler includes a feedwater tank, feedwater preheaters, boiler banks, sweet water condenser, steam drum, boiler wall pipes and superheaters. The starting point of boiler water and steam circulation is the feedwater system. Oxygen is removed from demineralized water in a feedwater tank. Feedwater is then pumped to a high pressure feedwater preheater that uses medium pressure steam. Number of pumps can vary case-by-case basis. Preheated feedwater enters then first heat transfer surface, economizer.

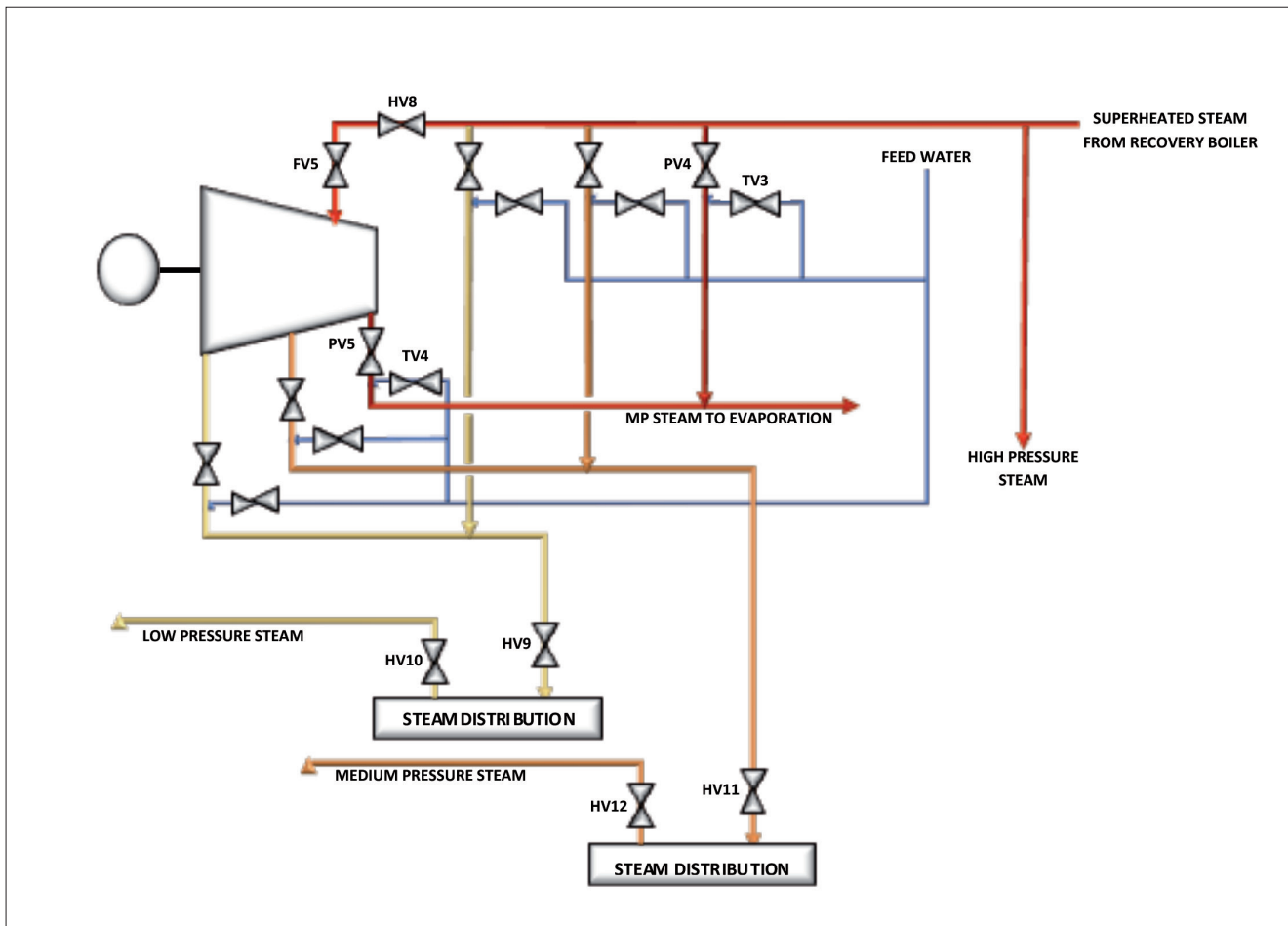
The economizer recovers heat from flue gases that flow from the furnace. Feedwater is preheated step by step close to the boiling point and fed into a sweet water condenser to generate desuperheated water. Steam is separated from water in a steam drum and fed into a condenser and superheaters. Superheated steam flows from superheaters into a main steam line. Sootblowing steam is taken between superheaters and directed to superheaters, boiler banks, economizers and flue gas coolers.



Turbine

Steam turbine and generator produce electricity from high pressure and temperature steam (for example ~8,5 MPa / 480 °C). After superheaters the steam has to be well above saturation because moisture causes erosion of blades in steam turbines. Before the turbine a high pressure steam line is directed from the main steam line. Control valve is located before the turbine to control steam flow. The steam temperature and pressure decrease as the steam flows through the blades of the turbine.

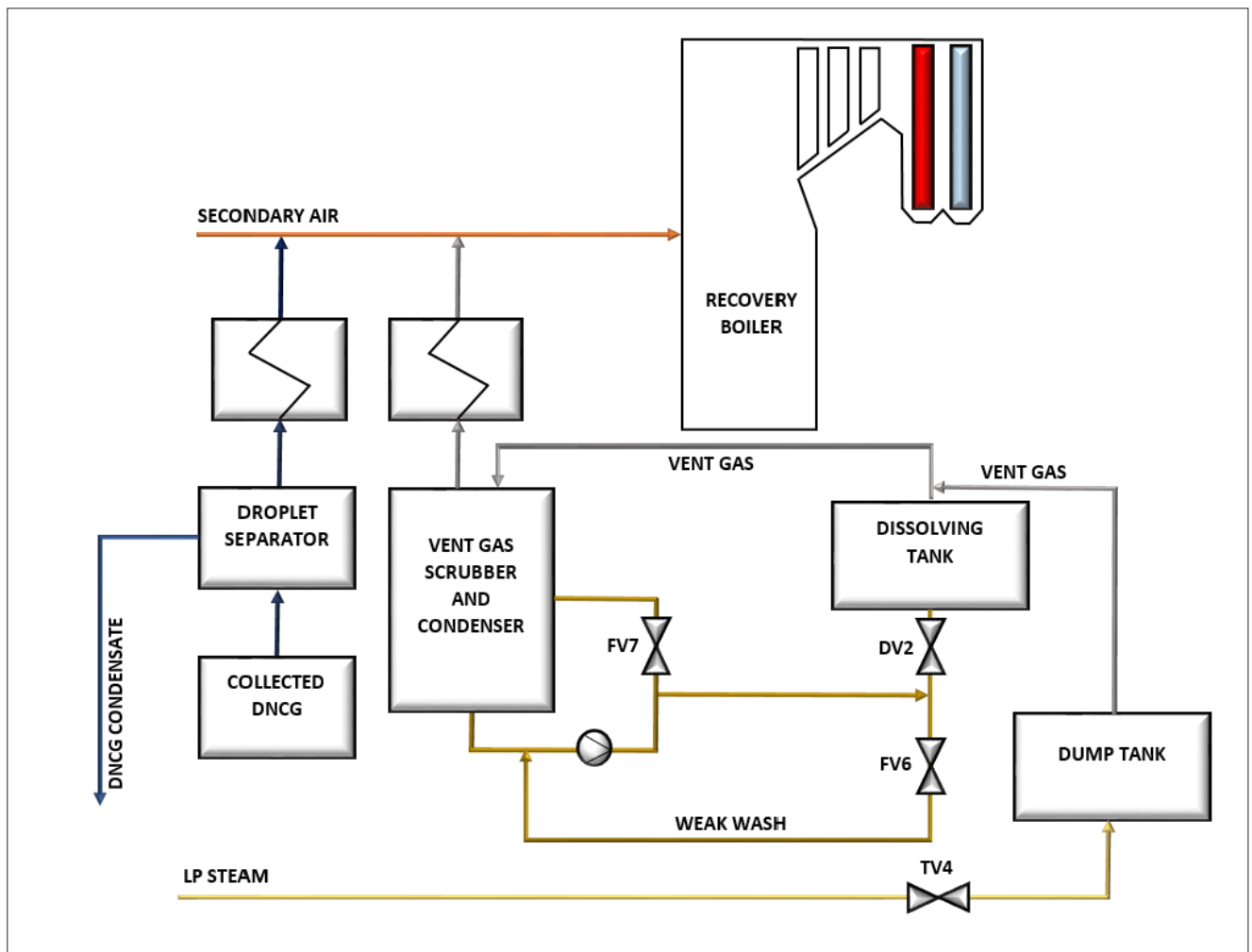
Because the pressure decreases, the volume of the steam increases, increasing its flow rate. The motion energy is utilized in the generator, which transforms the energy of the rotating movement into electric power. Medium pressure steam lines and a low pressure steam line are directed from the main steam line and after the turbine. Feedwater is used for cooling the steam to the correct temperature. The number of steam pipes directed from steam distribution varies and therefore the number of necessary valves after steam distribution varies.



Vent and odorous gases

The kraft pulping process produces odorous gases which are divided into diluted non-condensable gases (DNCG) and concentrated non-condensable gases (CNCG). Odorous gases consist of reduced sulphur compounds and are explosive when forming a suitable mixture with oxygen. They are formed during cooking, washing, evaporation, recovery boiler and lime kiln processes. Wet exhaust is formed in dissolving and dump tank. These gases are often burned at recovery boiler except CNCG. Vent gas system handles wet exhaust and weak wash from dissolving tank. Gas and weak wash is directed into a vent gas scrubber and moisture is removed with condenser. Then the gas is reheated and fed into a recovery boiler through secondary air (3,5-5 kPa).

DNCG are collected and fed into a droplet separator. Moisture is removed and the gas is then reheated and fed into a recovery boiler through secondary air. CNCG have very high risk of igniting and explosion. CNCG are collected into a piping and fed through ejector into a droplet separator. Then the gas is burned in a CNCG burner.



Valves

Valve	Media	Type	Typical Material	Note
DV1	Weak white liquor	RE_A__AJJST	CF8M	
DV2	Weak wash	LI2A__AA	CF8M	
FV1	Heavy black liquor	M_A__XVTA	4A	
FV2	Demineralized water	RE_A__ASJT2T	CF8M	Soft seated segment valve
FV3-4	Feedwater	G*	WCB	
FV5	Superheated steam	G*	WCB	
FV6-7	Weak wash	LI2A__AA	CF8M	
HV1-2	Heavy black liquor	M_A__XVTA	4A	
HV3	Green liquor	M_A__APTA	CF8M	
HV4	Demineralized water	_8_W113600XZC	CF8M	Soft seated butterfly valve or metal seated LW with K seat
HV5	Feed water	G*		
HV6-8,9-12	Superheated steam	G*	WCB	
LV1	Heavy black liquor	M_A__XVTA	4A	
PV1	Heavy black liquor	M_A__XVTA	4A	
PV2	Soot blowing steam	G*	WCB	
PV3	LP steam	RE_A__AJJST	CF8M	
PV4	Superheated steam	A or G**	WCB	
PV5	HP steam	G*	WCB	
TV1-2,5	MP steam	RE_A__AJJST	CF8M	
TV3,4	Feedwater	G*	WCB	

Valve types and materials must be checked case by case

*) G-series globe valve, type depends on recovery boiler conditions

***) G- or A-series globe valve, type depends on recovery boiler conditions

Subject to change without prior notice.

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