FLUE GAS HEAT RECOVERY
For reliable adherence to the increasingly more stringent emission standards, the demand for none-leakage heat recovery systems is growing. While in regenerative systems the leakage between raw gas and clean gas reduces the efficiency of flue gas cleaning, none-leakage heat recovery systems have already been developed by today’s Babcock Borsig Steinmüller in the 1980s and have since then proved their reliability in numerous reference plants even in operation on difficult fuels and below the acid dew point. Both for the recovery of raw gas heat for reheating the clean gas and steam-heated clean gas heaters, we have developed material and design concepts which have proved successful in practice.

The energy saving systems known by the name of POWERISE® recover the waste heat from the flue gas before entry into the flue gas desulphurization system (FGD) to preheat feedwater and air. The valuable extraction steam of the turbine used up to now for this purpose contributes to power generation in addition.

Heat recovery systems have been proved successful in numerous reference plants. At the beginning of a flue gas heat recovery project, we carry out a system analysis to evaluate the existing heat potential. It is economically advisable to replace air preheating by steam, condensate heating, feedwater preheating or district heat generation by heat recovery. Feasibility of replacing the steam supply depends on the temperature level of the fluid to be heated by the steam. The saved steam can then remain in the water-steam cycle and be expanded in the turbine. Thus, it contributes to power generation and increases the efficiency.
UPGRADING

Reduction of the CO2 emissions is a measure generally acknowledged worldwide for protection of the environment and climate. An essential step towards achieving this goal is an extensive upgrading of the existing fossil-fired power plants. Here, advanced flue gas heat recovery systems offer effective possibilities of improving the efficiency by generating so-called „green megawatts“ with simultaneous reduction of the waste heat given off to the atmosphere. Design and layout of these systems, in particular in the case of retrofitting existing power plants, require careful consideration of the marginal conditions resulting from thermo-dynamic, economic efficiency and mode of operation in close cooperation with the operator/-owner.

Advantages

- „Green megawatts“, increased electric power up to 3%
- Reduced fuel consumption
- Reduced CO2 emission
- Reduced water consumption of the FGD system
- Heat recovery to below the acid dew point
- Retrofit concepts
- Turn-key plants
- High operational safety and thus high availability
- Long service life due to corrosion-resistant design
- Experience with hard coal and lignite as well as oil-fired power plants since 1985

We subdivide flue gas heat recovery systems into ECO systems and POWERISE® systems:

1. ECO SYSTEMS

ECO SYSTEMS ARE NONE-LEAKAGE CLEAN GAS REHEATING SYSTEMS IN POWER PLANTS AND REFUSE INCINERATION PLANTS, THESE ARE IN DETAIL:

ECOGAVO

ECOGAVO is a highly developed, none-leakage heat displacement system. It includes a flue gas cooler and a clean gas heater which are separately arranged around the FGD plant.

The materials used have been proved in numerous reference plants and are suitable for cooling to below the acid dew point.

Via a connected closed water circuit the decoupled heat is transferred to a clean gas heater arranged downstream of the FGD plant where the steam-saturated clean gas is dried and heated to the required stack outlet temperature. Here too, well tested material concepts are carried out.

Fully automatic cleaning systems and the self-cleaning effect of the plastic tubes prevent excessive contamination and the connected pressure loss. Vibrations of the pipes are gently reduced by means of patented spacers. This solution also provides optimum design not restraining the flow of wash water and deposits through it.
ECOCRoss

ECOCRoss is a none-leakage and corrosion-resistant tubular cross-flow heat exchanger which is predominantly used in flue gas desulfurisation plants (FGD plants) for the reheating of clean gas. This leads to acid condensation on the inside tube surfaces of the heat exchanger. The heat exchanger tubes are therefore made of the fluoroplastic material G-FLON. Due to its anti-adhesive properties dust deposits on the tube surface are minimized.

Another advantage of G-FLON: A none-leakage welded connection is made between the tube and the foil lining of the tube sheet. Nevertheless, the tube can be individually exchanged, if necessary. Tube vibrations are efficiently prevented. Lining of G-FLON protects the casing against the corrosive clean gas. Although it was initially developed for waste incineration plants ECO-CROSS is nowadays also used in power stations for the reheating of flue gas downstream of the flue gas desulfurisation plant.

Due to its construction size the heat exchanger is split up in individual modules here. For length compensation specific solutions have been developed.

DAGAVO

Steam-heated gas preheater downstream of the flue gas desulfurisation plants and/or upstream of DeNOx plants. Downstream of the FGD plant the steam-saturated clean gas is to be dried and heated in order to protect the downstream plant components and to reach the temperature required at the stack outlet. In view of the existing flue gas conditions corrosion-resistant stainless steel tubes are used while the casing is provided with a G-Flon lining or high-grade steel cladding. To obtain the residual heating for DeNOx processes, heat is often supplied via a steam-heated gas preheater (DAGAVO). Due to its operation above the acid dew point this heat exchanger can be made of carbon steel often with finned tubes.
ECOFLOW

ECOFLOW is a heat displacement system in which heat is recovered from waste gas (250 °C - 600 °C) and carried via a closed heat transfer agent circuit to internal or external consumers. A closed and well insulated system of pumps and pipe-work connects the specially designed heat-exchangers on the heat supply and consumer side. Water or thermal oil is used as heat transfer medium. For example, the ECOFLOW system can be combined with an ORC system (Organic Rankine Cycle) for low-temperature power generation. The thermal energy is recovered by means of special waste gas coolers (heat source) and is transferred by means of thermal oil to the heat sink, the evaporator of the ORC cycle. The power generated in the ORC system is fed into the plant network for further utilisation.

Other application and utilisation examples are for example the preheating of air or combustion gas, generation of district heat, water heating or even steam generation. In addition to these basic applications a combination of circuit arrangements can be effected to simultaneously transfer the recovered energy to various consumers.

ADVANTAGES OF ECO SYSTEMS

- Absolutely no leakage
- „Green megawatts“, increased electric power
- Reduced fuel consumption
- Reduced CO2 emission
- Heat recovery below the acid dew point
- Retrofit concepts
- Turn-key plants
- Experience with hard coal and lignite as well as oil-fired power plants since 1985
- High operational safety and thus high availability
- Multiple large plants worldwide as references
- Long service life due to corrosion-protected design

ECOSTAT

ECOSTAT is an air heater or gas-gas heater operating on the heat pipe principle. It consists of heat pipes functioning independently of each other.

Heat transfer takes place by evaporation and condensation of the working fluid. For this purpose, a tube equipped with a special capillary system is evacuated and closed gas-tight at both ends. When heat is applied to the lower side of the tube the working fluid evaporates there and expands into the cold tube section where it condenses. In the process, it gives off the evaporation heat absorbed before. The condensate returns through the capillaries to the hot tube area. The temperature of the working fluid fluctuates around an equilibrium between heat absorption and heat emission.

The heat pipe is an interesting alternative to the recuperative tubular and regenerative rotating air heater. They are especially well suited for rather high pressure differences. In the combustion air heater of boilers, the heat pipes are arranged mostly horizontally, the flue gas and combustion air flowing vertically around them in countercurrent fashion.

In other applications, such as flue gas heating before DeNOx systems, clean gas reheating after flue gas desulphurization systems or in combustion gas and air heaters before blast preheaters in blast furnace plants, the heat pipes are arranged vertically.

DeNOx systems, clean gas reheating after flue gas desulphurization systems or in combustion gas and air heaters before blast preheaters in blast furnace plants, the heat pipes are arranged vertically.
HIGHLIGHTS OF ECOSTAT

- “Green megawatts”, increased electric power
- Experience in DeNOx systems since 1980
- FGD system reheating since 2000
- Compact adjustment to the FGD system geometry
- High operational reliability and availability
- Non-leakage heat recovery systems according to DIN, no slip between the fluids
- No temperature variations, uniform temperature profile at the outlet ends
- Heat pipes individually replaceable, if required adjusted to counterflow arrangement of flue gas ducts
- No moving parts, therefore no drive energy required
- The concept can be flexibly designed in accordance with the customer's requirements

ECONOMISER FOR HEAT RECOVERY

The ECONOMISER is an indirect flue gas cooler which can be used for capturing thermal energy from a wide variety of flue gases. The design and material concept depend in each case on the field of application: For example, flue gas cooling with or without temperature dropping below the dew point or high or low dust loading.

Corresponding design and application examples are described under the products POWERISE® for power plants and ECOFLOW for industrial solutions.

STEAM AIR HEATERS FOR COMBUSTION AIR HEATING AS ORIGINAL OR RETROFIT EQUIPMENT

The steam-heated air heater is used for preheating of combustion air before boiler inlet. This air heater can be arranged upstream of a flue gas-heated regenerative air heater. In this case, the steam-heated air heater has the function to preheat the primary air to such an extent that in the flue gas-heated air heater the temperature does not drop below the dew point at the so-called “cold end”. Since the air does not contain any harmful substances carbon steel is here used as material. To be able to utilize the excellent heat transfer in the pipe for the most compact possible dimensions elliptical fin tubes are used. This pipe form assists in minimizing the pressure drop.

2. POWERISE®

INCREASE OF THE POWER PLANT EFFICIENCY AND REDUCTION OF CO2 EMISSIONS BY HEAT RECOVERY IN THE FLUE GAS PATH.

LOW-PRESSURE FEED WATER PREHEATING

In flue gas desulphurisation plants without reheating facility the heat potential of the flue gases is recovered by means of special corrosion-protected heat exchangers and transferred to the low-pressure feed water via a heat transfer agent circuit and an intermediate heat exchanger. The bleed steam of the turbine saved in this way is thus available for an increase of electric power.
PREHEATING OF COMBUSTION AIR

To avoid corrosion problems on the so-called „cold end” of a regenerative air heater an additional steam-heated fin-tube heat exchanger is often connected upstream which raises the temperature level of the air heater above the acid dew point. The energy required for this purpose is normally supplied to the heat exchanger by means of process steam which will therefore not be available for the generation of power.

As a replacement for this the required thermal energy is taken from the flue gas upstream of the flue gas desulphurisation plant by means of corrosion-protected heat exchangers so that the primary station consumption is reduced.

AIR HEATER BYPASS-ECONOMISER (LUBECO)

In FGD plants without reheating facility the heat potential of the flue gas is recovered by means of special corrosion-resistant heat exchangers and is transferred to the regenerative air heater via a heat transfer agent circuit and via an additional air heater.

A part of the energy of the high-temperature boiler flue gas is thereby branched off and transferred via a air heater bypass economiser to the high and low-temperature feed water. With this patented circuit arrangement the utilised heat is raised to a high temperature level. Valuable bleed steam is saved and is available for an increase of electric power.

For further information on our products in the field of heat recovery, please see our documentation of installed plants and our reference lists.