Energy Conservation in Refineries: Challenges & Potential Areas in Motive Equipment

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Challenges in Continuous Process Plants with Cogeneration Systems

- Electricity conservation potential is limited by the extent of power generated by the steam condensing part of the total generation. For additional energy savings, equivalent steam savings have to achieved to maintain the heat and power balance.
- When inefficiencies in rotary equipment and related circuits are eliminated, the frictional heat added to the fluids reduce. In circuits with subsequent heating, this heat may have to be substituted by additional firing in furnaces or auxiliary boilers.
- Major process rotary equipment have option of either electric motor and steam turbine as prime mover, the use is governed by the prevailing steam and power balance and other contingencies.
- Lowest fuel consumption and energy cost at the complex level (including petrochemicals) is the driving force and not only the Crude Oil Refinery defined by the PAT boundary.
- Process licensors' permission may be required for major retrofits.
- Financial viability may difficult to justify if cost of shutdown is factored in.
- Frequency and time gap between shutdowns is often longer that the 3-year time cycle of PAT.

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Optimising Efficiencies of Cooling Water Pumps

- Refineries usually use cooling water pumps operating with discharge pressures in the range of 4 – 6 kg/cm^2(g) and flow in the range of 1000 – 6000 m^3/h are often observed to be working at operating efficiencies in the range of 65% to 75% or lower. This situation may be due to mismatch between design duty point and actual operating point, operation of additional pumps for reliability or pump wear due to poor metallurgy.
- For the operating head of 40-60m, flow of 1000 – 6000 m^3/h at low speeds @ 960 rpm, the achievable efficiencies are above 87%.
- Customised impeller retrofits can help achieve operating efficiencies close to 85%. Care may be taken to ensure that new impeller designs are done by experienced designers after a detailed study of site issues. Change in MOC of impeller may be required.
- Often major pump suppliers may not be the only best resource for impeller retrofits. There are medium scale manufacturers with excellent design expertise and experience, specialising in impeller retrofits of large pumps.

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Optimising Efficiencies of Compressed Air System

- The compressed air system pressures are usually maintained in the range of 8 – 9 bar. 3-stage centrifugal are commonly used as base load machines.
- For new purchases, 4-stage compressors may be preferred.
- From the view point of operations, intercooler performance is key to maintaining the efficiency of compressors.
- Suction filter cleanliness is important, pressure drop should also be monitored and maintained in acceptable range.
- *Heat of Compression* dryers may be preferred in place of electrically or steam heated dessicant regenerative dryers.
- Rationalisation of pressures may be done by optimising pressures at end-use points and finally also reducing the discharge pressure setting to the extent possible.

Optimising Efficiencies of Process Pumps

- Throttling of control valves is often observed in process hydraulic circuits, often resulting in significant energy loss.
- Reduction in number of stages of pumps or use of Variable Speed Drives can help minimise pressure drops in valves.
- Medium Voltage Variable Frequency Drive (VFD) technology has now matured, though still Refineries still doubt their reliability. Alternatively, Fluid couplings may be considered as retrofits, these are highly reliable, though energy savings may be less than with VFDs. While retaining the pump position, the motor will have to shifted slightly to accommodate the fluid coupling.
- Multiple streams are common in pump-around loops, often for product removal. The pressure demands of the pump-around loops and product removal loops are different. Installation of separate pumps for the pump-around loop and that for product removal can often lead to large savings.

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Optimising Efficiencies of Process Pumps

- Throttling of control valves is often observed in process hydraulic circuits, often resulting in significant energy loss.
- Significant spill-back of fluids is also often observed, especially in high pressure reciprocating pumps.
- Reduction in number of stages of pumps or use of Variable Speed Drives can help minimise pressure drops in valves.
- Medium Voltage Variable Frequency Drive (VFD) technology has now matured, though still Refineries still doubt their reliability. Alternatively, Fluid couplings may be considered as retrofits, these are highly reliable, though energy savings may be less than with VFDs. While retaining the pump position, the motor will have to shifted slightly to accommodate the fluid coupling. Electronic governors may be used for turbo-driven pumps.
- Multiple streams are common in pump-around loops, often for product removal. The pressure demands of the pump-around loops and product removal loops are different. Installation of separate pumps for the pump-around loop and that for product removal can often lead to large savings. Retrofits are possible if there is constraint of space.

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Optimising Efficiencies of Process Compressors

- Intercooler performance is key to maintaining compressor efficiency; appropriate water treatment to minimise fouling is recommended.
- Throttling of suction valves or inlet guide vanes is often observed in centrifugal compressors, often resulting in significant energy loss.
- Significant spill-back of fluids is also often observed.
- Variable Speed Drives can help eliminate suction control pressure drops and minimise spill-back to minimum levels.
- Medium Voltage Variable Frequency Drive (VFD) technology has now matured, though still Refineries still doubt their reliability. Alternatively, Fluid couplings may be considered as retrofits, these are highly reliable, though energy savings may be less than with VFDs. While retaining the pump position, the motor will have to shifted slightly to accommodate the fluid coupling. Electronic governors may be used for turbo-driven pumps.
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Thank you!