Compressor power consumption

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1. Formula - isentropic compression. For 1 compressor stage Note : in case of multi ...

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The goal of compressor sizing calculations is often to find out the efficiency of the compressor and power required to drive that compressor, given the gas composition, flow rate, temperature & pressure conditions at inlet and outlet pressure requirement.

Let's look at equations frequently used in compressor calculations to determine power and efficiency of the compressor along with their description and significance.

Gas compression can be expressed in terms of pressure and temperature variation as,PVn = constant

A compression process typically following this pressure volume relation is known as polytropic process. If n=1, the process is isothermal (constant temperature). If n=g=CP/CV, the compression is adiabatic compression (no heat exchange with the surrounding). Most gas compressions generally follow the adiabatic curve. Hence compressor equations are also based on adiabatic curve with n=g,PVg = constant

Let subscripts 1 and 2 stand for inlet and outlet process conditions of the compressor. Then the pressure ratio of the compressor is P2/P1.P2/P1 = (V1/V2)n ... Polytropic compressionP2/P1 = (V1/V2)g ... Adiabatic compression

The head developed by the compressor is expressed in following compressor equations.

This head when multiplied by the volumetric flow of gas (Q) gives the compressor power equations.

Adiabatic efficiency of the compressor is calculated as,

Adiabatic efficiency, i = (Actual Polytropic work / Adiabatic work)

Polytropic efficiency or hydraulic efficiency for a compressor is represented by,

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