Objective:

Science, Physics

OBJECTIVE: 1. To demonstrate the isentropic expansion process.

INTRODUCTION: In thermodynamics, an isentropic process is one in which for purposes of engineering analysis and calculation, one may assume that the process takes place from initiation to completion without an increase or decrease in the entropy of the system . If a compression or expansion of a gas takes place with no flow of heat energy either into or out of the gas - the process is said to be isentropic or adiabatic. The isentropic (adiabatic) process can be expressed with the Ideal Gas Law as: p / Ï�k = constant where k = cp / cv - the ratio of specific heats - the ratio of specific heat at constant pressure - cp - to the specific heat at constant volume - cv The isentropic or adiabatic process can also be expressed as pVk= constant or p1V1k = p2V2k   The Second law of thermodynamics states that, where Î´Q is the amount of energy the system gains by heating, T is the temperature of the system, and dS is the change in entropy. The equal sign will hold for a reversible process. For a reversible isentropic process, there is no transfer of heat energy and therefore the process is also adiabatic. For an irreversible process, the entropy will increase. Hence removal of heat from the system (cooling) is necessary to maintain a constant internal entropy for an irreversible process in order to make it isentropic. Thus an irreversible isentropic process is not adiabatic. For reversible processes, an isentropic transformation is carried out by thermally " insulating" the system from its surroundings. Temperature is the thermodynamic conjugate variable to entropy, thus the conjugate process would be an isothermal process in which the system is thermally " connected" to a constant-temperature heat bath.

MATERIAL AND METHODOLOGY: Material: - Apparatus: Perfect gas expansion unit. Methodology: 1. The general start up procedures as stated in Appendix A were performed. All the valves were made sure to be fully closed. 2. The hose from compressive pump to pressurized chamber was connected. 3. The compressive pump was switched on and the pressure inside the chamber was allowed to increase up to about 160kPa. Then, the pump was switched off and the hose was removed from the chamber. 4. The pressure reading inside the chamber was monitored until it stabilizes. The pressure reading PT 1 and temperature TT 1 were recorded. 5. Then, valve V 01 was slightly opened and the air was allowed to flow out slowly until it reached the atmospheric pressure. 6. The pressure reading and the temperature reading after the expansion process were recorded. 7. The isentropic expansion process was discussed. RESULTS: Before expansion P1 | T1 | 160. 1kpa | 24. 6ºC | After expansion P2 | T2 | 99. 8kpa | 23. 2ºC | DISCUSSION: Isentropic means no change in entropy. Entropy is a type of energy (like heat, work, enthalpy) and is by definition energy which is lost in a process. We say it is lost because we can't generate any useful energy from it e. g. work. For example your car engine turns heat into work (heat of burning fuel into work of powering your car engine) but some of the heat creates entropy which is why the car engine isn’t 100% efficient. Expansion - this is the increase in volume of a gas. The mass or the amount of gas there doesn’t change but its volume does. Pressure, temperature and volume of a given amount of gas are all interlinked. . For a reversible isentropic process, there is no transfer of heat energy and therefore the process is also adiabatic. For an irreversible process, the entropy will increase. Hence removal of heat from the system (cooling) is necessary to maintain a constant internal entropy for an irreversible process in order to make it isentropic. Thus an irreversible isentropic process is not adiabatic. Expansion will cause a change in pressure if temperature is held constant (Isothermal = no change in T, but this will not be isentropic), or a change in temperature if pressure is held constant (Isobaric = no change in P, but again not isentropic) These won’t be isentropic because some heat transfer is required to keep either P or T constant. In Isentropic expansion processes bit of both occur i. e. both temperature and pressure change. An isentropic process is an idealisation of the expansion process which assumes there is no heat transfer between the system and its surroundings. No heat transfer is called " adiabatic". We can say this because entropy is directly related to heat transfer by the equation dQ = TdS (dQ = heat transfer, T = temp, dS = change in entropy, so if dQ = 0 then dS = 0 . CONCLUSION; The objective has been achieved in this experiment which, the isentropic expansion process is demonstrated. For a reversible isentropic process, there is no transfer of heat energy and therefore the process is also adiabatic. For an irreversible process, the entropy will increase. LIMITATIONS: 1. The pressure in the chamber must not exceed 160kPa. 2. The safety valve must be open slowly when releasing the pressurized air. REFERENCE: 1. Definition of Isentropic Expansion Process. Retrieved on Sept 21st, 2012, from http://www. merriam-webster. com/Isentropic Expansion Process 2. http://en. wikipedia. org/wiki/Isentropic_process . Retrieved on Sept 21st, 2012 3)Isentropic Expansion Process Discussion. Retrieved on Sept 21st , from http://www. answers. com/topic/ Isentropic Expansion Process Discussion 4. What is Isentropic expansion in easy-to-understand terminology

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