REVERSIBLE AND IRREVERSIBLE PROCESS

A *reversible* process is defined as a process that can be reversed without leaving any trace on the surroundings. It means both system and surroundings are returned to their initial states at the end of the reverse process.

Reversible processes do not occur and they are only idealizations of actual processes. We use reversible process concept because, a) they are easy to analyze (since system passes through a series of equilibrium states); b) they serve as limits (idealized models) to which the actual processes can be compared.

Some factors that cause a process to become irreversible:

• Friction

• Unrestrained expansion and compression

• Mixing

• Heat transfer (finite ΔT)

• Inelastic deformation

• Chemical reactions

In a reversible process things happen very slowly, without any resisting force, without any space limitation $\rightarrow$ everything happens in a highly organized way (it is not physically possible - it is an idealization).

Internally reversible process: if no irreversibilities occur within the boundaries of the system. In these processes a system undergoes through a series of equilibrium states, and

when the process is reversed, the system passes through exactly the same equilibrium states while returning to its initial state.

Externally reversible process: if no irreversibilities occur outside the system boundaries during the process. Heat transfer between a reservoir and a system is an externally reversible process if the surface of contact between the system and reservoir is at the same temperature. Totally reversible (reversible): both externally and internally reversible processes.

Examples: Some examples of nearly reversible processes are:

(*i*) Frictionless relative motion.

(*ii*) Expansion and compression of spring.

(*iii*) Frictionless adiabatic expansion or compression of fluid.

(*iv*) Polytropic expansion or compression of fluid.

(*v*) Isothermal expansion or compression.

(*vi*) Electrolysis.

An *irreversible process* is one in which heat is transferred through a finite temperature. In summary, processes that are not reversible are called *irreversible*.

Examples of irreversible process.

(*i*) Relative motion with friction	(*ii*) Combustion
(*iii*) Diffusion	(*iv*) Free expansion
(*v*) Throttling	(*vi*) Electricity flow through a resistance
(*vii*) Heat transfer	(*viii*) Plastic deformation.

Irreversibilities are of *two types:*

1. **External irreversibilities.** These are associated with *dissipating effects outside the working fluid*.

Example: Mechanical friction occurring during a process due to some external source.

2. **Internal irreversibilities.** These are associated with *dissipating effects within the working fluid*.

Example: Unrestricted expansion of gas, viscosity and inertia of the gas.

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