**7. AVAILABILITY**

**AVAILABLE ENERGY:** The maximum work which can be obtained in a cycle.

**UNAVAILABLE ENERGY:** The minimum heat which is rejected to the atmosphere.

**AVAILABILITY:** the maximum work which can be obtained in a process.

**IRREVERSIBILITY:** It’s defined as difference between the maximum work and the actual work.

**METHODS TO IMPROVE CARNOT CYCLE EFFICIENCY:**

|  |  |
| --- | --- |
| **INCREASING SOURCE TEMPERATURE** | **DECREASING SICK TEMPERATURE** |
| Efficiency increase per unit increase in temperature is less in comparison. | Efficiency increase per unit increase in temperature is more. So, it’s best method to increase efficiency of Carnot cycle. |
| It depends on working fluid and it’s calorific value. So, maximum value increase with quality of working fluid. | It depends on minimum possible heat rejection temperature. E.g. |

**AVAILABLE ENERGY:**

|  |  |
| --- | --- |
|  |  |
| It can be increase by decreasing temperature. | It can be increase by increasing temperature. |
| **1st Law of T.D. is Quantitative law.** | **2nd Law of T.D. is Qualitative law.** |

**UNAVAILABLE ENERGY:**

|  |  |
| --- | --- |
|  | |
|  |  |

**AVAILABLE ENERGY BETWEEN FINITE BODY & THERMAL RESERVOIR:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Always consider magnitude. will be negative but consider magnitude in this equation. | |  |  |  | | --- | --- | --- | |  |  | Finite Body | |  |  |  | |  |  | Reservoir | |

**LOSS OF A.E. OR DECREASING A.E. OR INCREASING U.A.E.:**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Here, | Hence, |
|  | | | |

**EXERGY:** The maximum useful work which can be obtained from a system as it reversibly comes into equilibrium with its environment. It is combined word used for A.E. & Availability.

**DEAD STATE:** It’s state at which system and surroundings are in equilibrium.

**AVAILABILITY IN NON-FLOW PROCESS:**

**CHANGE IN AVAILABILITY ():**

|  |  |  |  |
| --- | --- | --- | --- |
|  | N.F.E.E.: |  |  |

**AVAILABILITY/ WORK POTENTIAL AT A STATE :**

Availability/ work ability at a state *"i"* is composite property (extensive) of system and surroundings.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SURROUNDINGS WORK:** |  |  |  |  |

|  |  |  |
| --- | --- | --- |
| **MAXIMUM USEFUL WORK:** |  |  |

**AVAILABILITY FUNCTION:**

|  |  |
| --- | --- |
|  |  |

**AVAILABILITY IN FLOW PROCESS:**

**CHANGE IN AVAILABILITY ():**

|  |  |  |
| --- | --- | --- |
|  | S.F.E.E. |  |

**SURROUNDINGS WORK:** (No atmospheric resistance)

**MAXIMUM USEFUL WORK:**

**AVAILABILITY/ WORK POTENTIAL AT A STATE :**

Availability/ work potential at a state *"i"* is composite property (intensive) of system and surroundings.

**AVAILABILITY FUNCTION:**

|  |  |
| --- | --- |
|  |  |

**IRREVERSIBILITY (I):** It represents loss of work or available energy or availability.

|  |  |
| --- | --- |
|  |  |
|  |  |

**IRREVERSIBILITY BETWEEN THERMAL RESERVOIRS:**

**IRREVERSIBILITY IN FREE EXPANSION/ THROTTLING PROCESS:**

**IRREVERSIBILITY IN ADIABATIC MIXING PROCESS:**

**IRREVERSIBILITY IN FLUID FRICTION IN AN ADIABATIC PIPELINE:**

|  |  |
| --- | --- |
| From, S.F.E.E.: |  |
|  | |

**SECOND LAW EFFICIENCY:**

|  |  |
| --- | --- |
| **FOR HEAT ENGINES,** | **FOR TURBINES,** |
|  |  |
| **FOR REFRIGERATOR,** | **FOR COMPRESSORS,** |
|  |  |
| **FOR HEAT PUMP,** | **FOR HEATING COIL,** |
|  |  |