Salahaddin University - Erbil

College of Agricultural Sciences Engineering

Food Technology Department

Third year

F.P.E. (Practical)

2021-2022

3 Hours

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**Lecture 1 \ Units and Dimensions**

1. **Introduction**

It is necessary to understand the fundamentals of the units and dimensions due to the vast variety of the words and idioms related to them. Eventually, dealing with the different units and converting them during switching on, working and observing the machines and devices of food industry.

* 1. Definition:

Food Plant Engineering deals with designing, building, and managing food processing facilities. It aims to gain the biggest interest with the least expenses. For reaching this aim it deals with particular charts and calculations.

* 1. Dimensions and Units:

It is essential to know the necessary dimensions and units and how to use and convert them in order to understand and deal with calculations and charts in food plant engineering.

* 1. **Defining Units and Dimensions**

‘Dimension’ are expressions of the physical type quantity. For example: length, area, volume, time, force, mass, acceleration, temperature, energy, … etc. are different dimensions. These dimensions could be expressed with other dimensions, for instance: area is square length and acceleration is distance in time.

While ‘units’ are expressions which are used to determine the volume or size of a physical quantity, such as inch (in), foot (ft.), centimeter (cm) and meter (m) are units of length.

* 1. **Defining Several Derived Units**
     1. Force: a force (F) that influence a mass (M) and moves it with an acceleration of (m/s2) is:

F=m\*a = m [kg]\* a [m/s2] = ma [kgm/s2]

= ma [N]

* + 1. Pressure: a pressure (P) is the force (F) in a specific area (A):

P=F/A =F [N]/A [m2] = F/A [N/m2]

P= F/A [Pa]

* + 1. Energy: Energy (E) is the force (F) used for movement along a distance (l):

E=F\*l = F [N]\*l [m] = Fl [Nm]

= Fl [J]

* + 1. Power: power (Pr) is the average of using energy (E):

Pr = E\*T = E [J]\*T [s] = ET [Js]

= ET [W]

* 1. **International System Units (SI Units):**
     1. Base Units: are the units from which the other units are derived. They include:

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Symbol | Unit | Symbol |
| Length | l | Meter | m |
| Mass | m | Kilogram | kg |
| Time | t | Second | s |
| Temperature | T | Kelvin | k |

* + 1. Derived Units:

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Symbol | Unit | Symbol |
| Force | F | Newton | N |
| Pressure | P | Pascal | Pa |
| Energy | E | Joule | J |
| Power | Pr | Watt | W |

* + 1. Other Units:

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Symbol | Unit | Symbol |
| Volume | V | Liter | l |
| Mass | m | Ton | t |
| Pressure | P | Bar | bar |

* + 1. Converting several common units:

|  |  |
| --- | --- |
| Length | 1 in = 0.025 m  1 ft = 0.305 m  1 yd = 0.914 m |
| Area | 1 in2= 6.542 cm2  1 ft2= 0.093 m2  1 yd2= 0.836 m2 |
| Acceleration | 1 km/h = 0.277 m/s  1 mile/h = 0.44694 m/s |
| Mass | 1 lb = 453.6 g = 0.454 kg  1 short ton = 970.2 kg = 0.907 t  1 long ton = 1016 kg = 1.016 t |
| Pressure | 1 atm = 101325 Pa = 1.01325 bar  1 torr = 1 atm/760 = 133.322 Pa = 1.33322 mbar  1 mmHg = 133.322 Pa = 1.33322 mbar  1 psi = 1 Ib/in2 |
| Energy | 1 J = 2.77778e-7 kWh  1 kcal = 4.1868 kJ |
| Power | 1 kW= 1.34 HP  HP = 0.953 Btu/s  1 HP = 0.746 kW |

* + 1. Some common prefixes:

|  |  |  |  |
| --- | --- | --- | --- |
| Prefix | Symbol | Value | Example |
| Nano | N | 10-9 | Nm |
| Micro | μ | 10-6 | μm |
| Milli | m | 10-3 | mm |
| Centi | c | 10-2 | cm |
| Deci | d | 10-1 | dm |
| Kilo | k | 103 | Kg |
| Mega | M | 106 | MHZ |

* 1. Converting Units:

While converting units, it is necessary to multiply the value of 1 unit of the converted one by the amount of the required one to be converted. For example:

1 ft. = 0.3048m, for converting 3 ft. into m, simply 3 has to be multiplied by 0.3048,

3 ft. \* 0.3048 m/ft. = 0.9144m