

## **CEN 212 FLUID MECHANICS**

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# DIMENSIONLESS EQUATIONS

and

# DIMENSIONAL ANALYSIS

- Equations which consist of terms having the same units are called dimensionally homogeneous equations. When such an equation is divided by any one of its terms, all units in each term cancel and only numerical magnitudes remain. These equations are called dimensionless equations.
- Mathematically derived equations are homogeneous dimensionless equations.
- Equations derived by empirical methods are usually dimensional equations.

# DIMENSIONLESS EQUATIONS

and

# DIMENSIONAL ANALYSIS

- Many important engineering problems cannot be solved completely by theoretical mathematical methods. Empirical methods are laborious and it is difficult to correlate the results.
- Dimensional analysis depend on the fact that if a theoretical equation exists among the variables affecting a physical process, that equation should be dimensionally homogeneous.

# DIMENSIONLESS EQUATIONS

and

# DIMENSIONAL ANALYSIS

- Rayleigh Method

According to Rayleigh method, all terms in the function,  $f$  must have the same dimensions as those of the left hand side of the equation.

- Buckingham Method

In this method listing of the important variables is done first. Then the number of dimensionless parameters are determined.

DIMENSIONLESS  
EQUATIONS

and

DIMENSIONAL  
ANALYSIS

**WRITE THE FUNCTIONAL RELATIONSHIP**



**DETERMINE THE NET POWER OF EACH DIMENSION**



**APPLY THE PRINCIPLE OF DIMENSIONAL HOMOGENITY**



**SOLVE THE EQUATIONS**