Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Mustaqbal University College

Chemical Engineering and Petroleum Industries Department

Subject: Oil and Gas Field Processing

3rd Class

Lecture 10

BURNERS

Principles of Burner Design

How does combustion occur?

The release of potential energy of fuel by combustion with air requires several stages, namely.

• Mixing of air and fuel

• Ignition of the mixture

• Chemical reaction

• Disposal of products of combustion from the reaction site.

So that fresh reactants are a vailable, that each mole of carbon theoretically requires 1 mole of oxygen for complete combustion. But 1 mole of oxygen is obtained from 4.76 moles of air. That means 3.76 moles of nitrogen are present with 1 mole of oxygen. Nitrogen is inert and does not take part in combustion therefore mixing of air + fuel is important.

What is a burner?

A burner is a mechanical device that

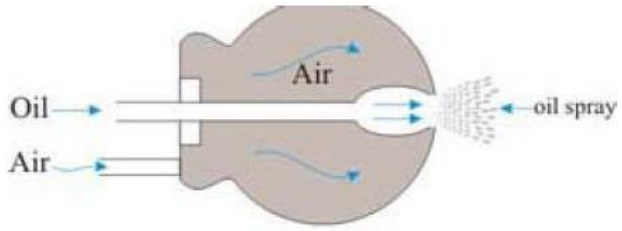
• supplies required amount of fuel and air

• creates condition for rapid mixing of fuel and air

• produces a flame which transfers thermal energy to furnace.

In oil burners, oil is atomized into a fine spray by a spray nozzle and air is supplied for combustion in the spray chamber. Alternatively oil may be atomized by high speed air to produce a fine dispersion of droplets into air. There are liquid fuel and

gaseous fuel burners. In liquid fuel burner, oil is heated and atomised either mechanically or by high speed gaseous jet. In mechanical methods oil is atomised by means of a rotating disc or cup or by swirler as shown in the figure 1a and b.



(a) Rotary cup burner

Figure1: Spreading of an axis-symmetric jet in the surrounding

Mechanical atomization produces wider spray of oil and wide flame area with uniform droplet size.

In atomization, compressed air or steam is the atomizing fluid. Air atomization produces higher flame temperature than steam atomization. Steam atomization is preferred for viscous oil.

A gaseous fuel burner could either be of premixed type or diffusion type. In a pre-mixed type gas and air are mixed prior to passing through the nozzle. In diffusion type fuel and some amount of air is mixed and the mixture is passed through the burner. Rest air for combustion is supplied in the furnace chamber. Combustion of fuel is controlled by the rate of mixing of air and fuel. In these burners small portion of air is mixed with fuel as primary air and the rest amount, known as secondary air is supplied in the furnace. Industrial burners for gaseous fuel are diffusive type.

Mixing of air and gaseous fuel

In diffusion burner air and gaseous fuel are supplied separately in the furnace. In modt combustion systems mass of air is at least 8 to9 times than fuel. When air and fuel pass through the burner, the momentum flux of air is several times greater than fuel. Some fraction of total air is mixed with the fuel and this air is known as primary air. Rest amount of air, known as secondary air is supplied in the furnace through.