

Bitumens

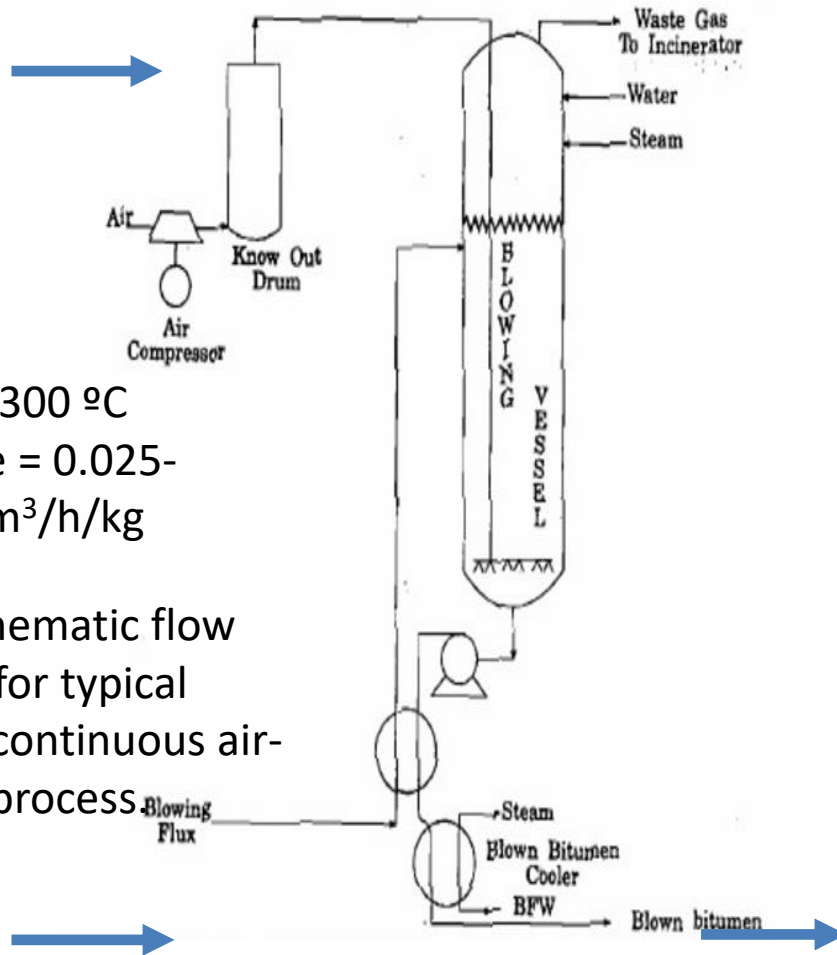
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Introduction

- **Bitumen** is a mixture of **Organic Liquids** that are highly **Viscous, Black, Sticky, Entirely Soluble in Carbon Disulfide**, and composed primarily of highly condensed **Polycyclic Aromatic Hydrocarbons**.
- Naturally occurring or crude bitumen is a sticky, tar-like form of petroleum which is so thick and heavy that it must be heated or diluted before it will flow. At room temperature, it is much like cold molasses. Refined **Bitumen** is the residual (bottom) fraction obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with the highest boiling point, boiling at 525 °C (977 °F).
- The word '**Asphalt**' refers to a mixture of mineral aggregate and bitumen (or tarmac in common parlance). The word '**Tar**' refers to the black viscous material obtained from the destructive distillation of coal and is chemically distinct from bitumen. **Bitumen** is referred to as '**Asphalt**' or '**Asphalt cement**' in engineering jargon. **Bitumen** is sometimes used as the generic term for road surfaces.

Air blowing Process



$T=240-300\text{ }^{\circ}\text{C}$
Air rate = $0.025-0.050\text{ m}^3/\text{h}/\text{kg}$

Fig -1 Schematic flow diagram for typical modern continuous air-blowing process

- Air Blowing Process in which hot asphalt is contacted with air.
- Dehydrogenation of residues, resulting in oxidation and condensation polymerization, increasing the overall molecular weight.
- The process provides products with properties that are unattainable by other means.
- The properties imparted to bitumen have made it adaptable to roofing waterproofing adhesive and sealing applications

Description

- The feed is preheated before being introduced into the column.
- The short residue is introduced into the blowing column just below the normal liquid level.
- Air is blown through the bitumen by means of an air distributor located at the bottom of the column. The air is not only the reactant but also serves to agitate and mix the bitumen, thereby increasing the surface area and rate of reaction. Oxygen is consumed by the bitumen as the air ascends through the material.
- Steam and water are sprayed into the vapour space above the bitumen level, the former to suppress foaming and dilute the oxygen content of waste gases and the latter cools the vapours to prevent after-burning.
- The "blown" product flows from the bottom of the blowing column into a surge drum via an external draw-off line. In this way the minimum level of product in the blowing column is controlled.
- From the surge drum the blown product is passed through heat exchangers to achieve the desired "rundown" temperatures and to provide an economical means of preheating the short residue, before pumping the product to storage.

Chemistry of the blowing process

- The aim of the blowing process is the formation of asphaltenes. Three phenomena can be identified:
 - * Reactions during which the size of the molecules increases; formation of esters is particularly important; they not only account for about 60% of the oxygen in blown bitumen but also link up two different molecules and thus contribute to the formation of material of higher molecular weight; this mechanism results in an increase in the asphaltene content and a change in the colloid-chemical constitution and rheological properties of the bitumen
 - * Reactions during which the size of the molecule is unchanged; formation of cyclic hydrocarbons by means of dehydrogenation with H₂O as a side product
 - * Reactions during which the size of the molecule decreases; separation of side branches from the molecules with blown distillate produced as a side product.

Types of Bitumens Produced

- The combination of Processes can be employed to produce a wide range of bitumens
 - Penetration
 - Viscosity Graded
 - Oxidised
- Blending is also used to produce intermediate grades.
- Flux oils including lube oil extracts may be used in processing in limited amounts to soften bitumens
- Extended Vacuum Distillation may be employed with limited air-blowing is employed for production Hard Grade bitumens. The starting material can be vacuum residue and/or Propane precipitated asphalt.
- Some very hard Bitumens with penetration less than 5 can be produces by thermal cracking followed by deep vacuum distillation for special applications

Cutback Bitumens

- Bitumens are blended with controlled amounts of petroleum distillates (White spirit, kerosene or gas oil) to produce relatively low viscosity products – Cutback Bitumens
- The large reduction in viscosity has given the name of the process as Cutting-back.
- Reduction in viscosity makes these products easier to handle than bitumens from which they are derived.
- The Initial properties of the Bitumens can be recovered by evaporating the diluent.
- Cutback Bitumens are produced in refineries by in-line or tank blending which can be controlled from knowledge of the bitumen and diluent characteristics.
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Effect of catalyst on product composition

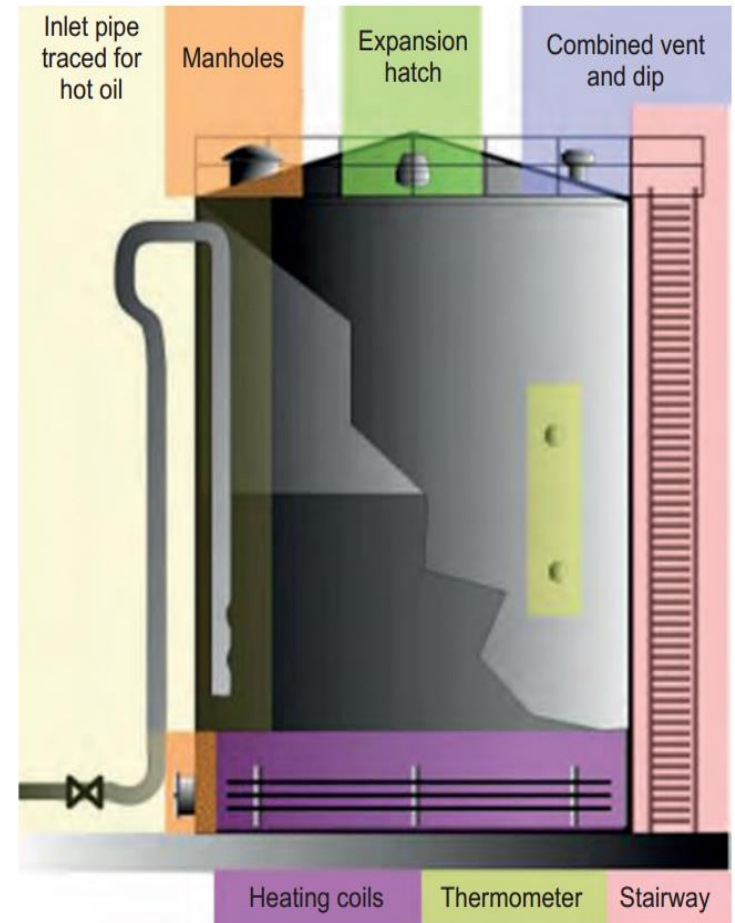
	Blowing Flux	Air blown bitumen	
		Without Catalyst	With ferric chloride as catalyst
Penetration at 25 C, 100g, 5s, 1/10mm	16.5	0.6	1.1
Softening Point C	41	112	117
Hydrocarbon group wt%			
(a) Saturates	53.9	51.6	36.0
(b) Aromatics	11.4	7.4	15.3
(c) Polar aromatics	16.7	6.0	6.3
(d) Asphaltenes	18.1	35.1	42.5

Bitumen emulsions

- An aqueous emulsified solution, formed by reacting fatty acid with dilute alkali or an organic amine with dilute acid along with hot bitumen are combined in a colloid mill or pump at high velocity.
- The shearing action produces fine particles of Bitumen dispersed in aqueous phase
- There are two main types of emulsion
 - Anionic - Bitumen particles are negatively charged
 - Cationic - Bitumen particles are positively charged
- Non-ionic emulsions and inverse emulsions, water in bitumen, may also be produced
- Bitumen emulsions are often produced in refineries but are also manufactured by independent companies.

Handling and distribution

- Bitumens, having high viscosities at ambient temperature, need to be heated before they can be handled.
- Bulk supplies are distributed using road tankers or rail tank cars at sufficiently high temperatures so that they arrive adequately hot for immediate use.
- Vehicles for transporting bitumens are often fitted with heating systems to ensure adequate discharge temperature even when anticipated delays occur.
- Road tanks are typically upto 20 tons capacity and have insulated tanks ensuring very slow cooling.
- Discharge is done by pressure or pumping.
- Bitumens are transported by sea in specially designed vessel fitted with heated tanks.



Thanks