Supplying the best

A complex production process is needed to ensure bitumen is a suitable component for today's highly engineered flexible carriageways.

Bitumen is a key ingredient of the macadams and asphalts used in roads and pavements, which enable efficient transportation of all types. It has its origins in the world's oil fields and is the product of the refining of crude oil.

Nynas bitumen is unique in being produced in refineries dedicated to bitumen

Crude oil from a number of parts of the world has proven to be acceptable for bitumen manufacture, Nigeria and the Middle East for example, but it is generally accepted that the highest quality bitumen, particularly bitumen emulsions, can be derived from Venezuelan crude oil.

North Sea derived crudes, for example, are unsuitable as they only contain a very small percentage of bitumen. Nynas has sourced its crude oil feedstock from Venezuela for many years and has found that this oil allows a high degree of certainty in assuring the consistent chemical composition of the bitumen products delivered to customers.

Nynas bitumen is unusual in that it is produced in refineries dedicated to bitumen — most other refiners derive bitumen as a by product of refining for other materials such as fuel oils.

The description which follows of how crude oil is refined applies particularly to Nynas' Dundee refinery — but is the same in all essentials for other refineries — where a process of fractional distillation is used, which separates crude oil into fractions on the basis of their different boiling points.

When required for refining, the crude is pumped through a heat exchanger system where the temperature is raised to, typically, 200 degrees centigrade, by exchanging the heat gained from the cooling of newly refined products.

The crude next passes through a furnace which heats it further to around 300 degrees centigrade and is turned partly to vapour which rises when it enters the atmospheric distillation column.

This steel tower operates at slightly above atmospheric pressure and is designed to achieve physical separation of the lighter components of the crude oil.

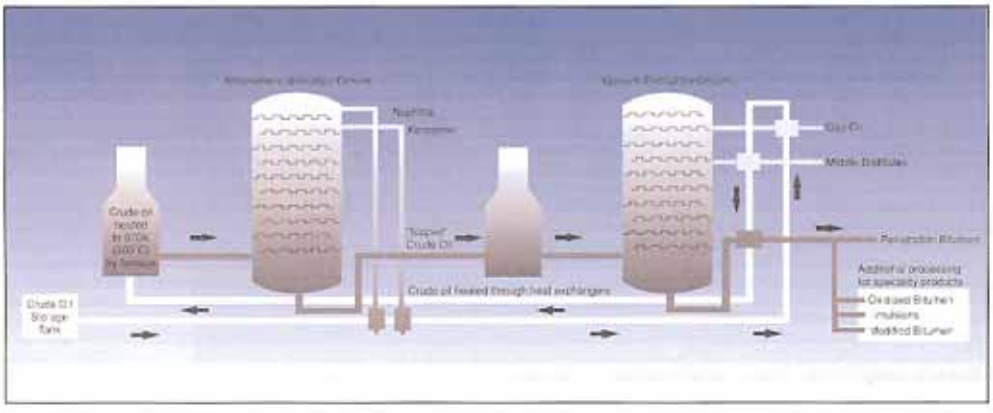
The column is hot at the bottom and cool at the top and is divided internally by horizontal steel trays at intervals throughout its height to collect condensed vapour. When the crude oil enters into the column, volatile fractions such as naphtha and kerosene vaporise (or boil) and the vapour rises up the column until its temperature falls below its boiling point.

The vapour then condenses and reverts to liquid form that is collected on the trays and taken from the column.

The column s internal composition has been designed to maximise contact between upwardly rising vapours and downward flowing liquids. The trays are punctured with holes to allow vapour to rise up the column.

Small dome shaped, spring loaded bubble caps are set above the holes to deflect the vapour downwards to make it pass through liquid already condensed on the trays.

At the Dundee refinery, the



How bitumen is produced

column was previously divided internally for its entire height. Recently the trays have been partially replaced by steel packing, which can be described as looking like cheese grater material configured in an egg box shape.

This material allows a higher throughput and a more efficient separation of the elements of the oil. Packing is progressively replacing the steel trays.

The column is tapped into at each level required and the product taken off as desired. Heavier products condense nearer the bottom of the column. This residue is taken to another furnace to be heated to around 350 degrees centigrade before entering a vacuum distillation column.

There, a similar process as before separates out gas oil, middle distillates and straight run bitumen. Vacuum distillation allows a lower operating temperature to be used which helps maintain the inherently high binding characteristics of Venezuelan crude oil.

The key to controlling what happens in the columns is the temperature of material going into the column and the material at the top. Great use is made by the operators of the refinery s ability to pump materials around, as energy can be pulled out of a column or added to it using the pumping systems.

Control at the top is assured by the refluxing of cooled material back while the furnace gives control at the bottom. In the vacuum column it is the temperature at the furnace that determines the hardness of the bitumen produced. The higher the temperature, the harder the bitumen and the lower the pen.

Nynas refineries in the UK produce only two grades of penetration bitumen and these are blended to make intermediate grades using a computerised blending system. Oxidised grades, harder bitumens, are produced by air blowing a straight run bitumen which is suitable for industrial uses such as mastic asphalts, roofing felt or pipe coating.

Penetration and oxidised bitumen are the principal products but some material is further processed in special plants to produce bitumen emulsions, polymer modified bitumens and other proprietary materials.

The refinery is required to run for around 300 days a year so it has to have reliability built in. Critical elements are any moving parts and that mostly means pumps, all of which are backed up with in line spares.

For economically efficient operation the refinery runs 24 hours a day with a staff of four operators backed by an increasingly sophisticated array of computerised control systems.

The vacuum distillation column at Nynas' Dundee plant, which produces world class bitumen products (above)