

Petroleum in India: Origin, Reserves, Production and other details

The word 'petroleum' has been derived from two Latin words Petra (meaning rock) and Oleum (meaning oil). Thus petroleum is oil obtained from rocks; particularly sedimentary rocks of the earth. Therefore, it is also called mineral oil.

Sedimentary rocks are types of **rock** that are formed by the deposition of material at the Earth's surface and within bodies of water.

Technically speaking, petroleum is an inflammable liquid that is composed of hydrocarbons which constitute 90 to 95 per cent of petroleum and the remaining is chiefly organic compounds containing oxygen, nitrogen, Sulphur and traces of organo-metallic compounds.

Crude petroleum consists of a mixture of hydrocarbons—solid, liquid and gaseous. These include compounds belonging to the paraffin series and also some unsaturated hydrocarbons and small proportion belonging to the benzene group.

Utilization of Petroleum:

Petroleum and petroleum products are mainly used as motive power. It is a compact and convenient liquid fuel which has revolutionized transportation on land, in the air and on water. It can be easily transported from the producing areas to the consuming areas with the help of tankers and more conveniently, efficiently and economically by pipelines.

It emits very little smoke and leaves no ash, (as is the case in coal utilization) and can be used up to the last drop. It provides the most important lubricating agents and is used as an important raw material for various petro-chemical products.

Origin and Occurrence of Petroleum:

Petroleum has an organic origin and is found in sedimentary basins, shallow depressions and in the seas (past and present). Most of the oil reserves in India are associated with anticlines and fault traps in the sedimentary rock formations of tertiary times, about 3 million years ago. Some recent sediment, less than one million years also show evidence of incipient oil.

Oil and natural gas originated from animal or vegetable matter contained in shallow marine sediments, such as sands, silts and clays deposited during the periods when land and aquatic life was abundant in various forms, especially the minor microscopic forms of flora and fauna.

Conditions for oil formation were favorable especially in the lower and middle Tertiary period. Dense forests and sea organisms flourished in the gulfs, estuaries, deltas and the land surrounding them during this period. The decomposition of organic matter in the sedimentary rocks has led to the formation of oil. Though oil is mainly found in sedimentary rocks, all sedimentary rocks do not contain oil.

An oil reservoir must have three pre-requisite conditions: (i) porosity so as to accommodate sufficiently large amounts of oil; (ii) permeability to discharge oil and/or gas when well has been drilled; (iii) the porous sand beds sandstone, conglomerates of fissured limestone containing oil should be capped by impervious beds so that oil does not dissipate by percolation in the surrounding rocks.

Oil on a commercial scale is usually found where the sedimentary rock strata are inclined and folded; in a sort of chamber or reservoir, in the highest possible situation e.g. crests of anticlines. Normally, oil is associated with water. Being lighter than water (specific gravity of 0.8 to 0.98), it collects in the anticlines or fault traps above the surface of water. Gas is still lighter and occurs above oil. Thus on drilling an oil well, one finds gas followed by oil, although gas seepage is not always a sure indication of an oil reservoir.

As already mentioned, oil as well as natural gas in India occur in sedimentary rocks. About 14.1 lakh sq km or about 42 per cent of the total area of the country is covered with sedimentary rocks out of which about 10 lakh sq km form marine basins of Mesozoic and Tertiary times.

Besides, the country has offshore areas having Mesozoic and Tertiary rocks of marine origin covering an area of 2.5 lakh sq km upto a depth of 100 metre and another area of 0.7 lakh sq km upto a depth between 100 and 200 metre. Thus the total continental shelf of probable oil bearing rocks amounts to 3.2 lakh sq km (see Fig. 26.4).

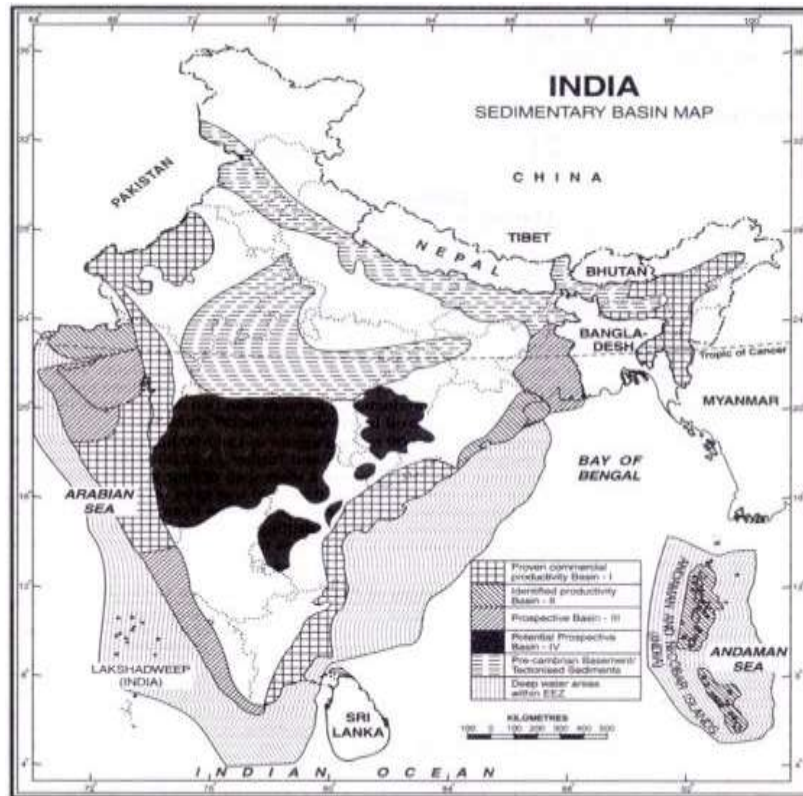


FIG. 26.4. India : Sedimentary Basin Map

The total sedimentary area including both on shore and offshore comprises 27 basins. The geological and geophysical studies have been conducted in 14 basins while exploratory drilling has been done in 9 basins. Mumbai High, the Khambhat Gulf and the Assam are the most productive areas.

Reserves:

Although India has vast areas covered by sedimentary rocks, structures containing oil are not in proportion to the expanses of these rocks and are found in limited situations. The Indian Mineral Year Book 1982 estimated a reserve of 468 million tonnes of which 328 million tonnes was available in Mumbai High. In 1984 the reserves were estimated at 500 million tonnes.

The Indian Petroleum and Natural Gas Statistics put the total reserves of crude oil at 581.43 million tonnes in 1986-87. The prognosticated hydrocarbon resource base in Indian sedimentary basins including deep water has been estimated at about 28 billion tonnes.

Of this only about one-fourth i.e., 7.2 billion tonnes of in place hydrocarbon reserves have been established as on 1 April, 2002. About 70 per cent of the

established hydrocarbon reserves is oil and rest is gas. The recoverable hydrocarbon reserves are of the order of 2.6 billion tonnes.

Production:

India was a very insignificant producer of petroleum at the time of Independence and remained so till Mumbai High started production on a large scale. In fact, off-shore production did not start till the mid 1970s and the entire production was received from on-shore oil fields.

In 1980-81 about half of the production of crude oil came from on-shore fields while the remaining half was received from the off-shore resources. After that juncture, the off-shore production increased at a much faster rate than the on-shore production. For more than two decades from 1990-91 to 2003-04, about two-thirds of production of crude oil is provided by the off-shore fields.

The production touched the all time peak of 34.09 million tonnes in 1989-90 but slumped to 30.44 million tonnes in 1991-92, 28.46 million tonnes in 1992-93 and further to 27.03 million tonnes in 1993-94. Sharp drop of production by over 7 million tonnes in a short span of four years is ascribed to overworking of Mumbai High oil wells. This was a dangerous trend and was to be reversed at all costs.

A number of short term and medium term measures such as early production from satellite fields, use of state-of-the-art technology i.e. horizontal drilling, drain hole drilling, etc. were initiated in 1993. As a result of these measures the production increased to 32.24 million tonnes in 1994-95, 37.24 million tonnes in 1995-96 and to 38.57 million tonnes in 1996-97.

A second phase of falling production was noticed after 1996-97 and the production stood at 31.9 million tonnes in 1999-2001. After 2001-02, a marginal increase in production has been recorded. In 2003-04 India produced 33.4 million tonnes of crude oil out of which 11.5 million tonnes came from on-shore sources while about twice that quantity, i.e., 21.9 million tonnes of oil was produced by off-shore oilfields.

India is obtained both from on-shore and off-shore areas, but off-shore areas made a major contribution (see Table 26.4 and 26.5)

Table 26.4 Production of Petroleum (Crude) in India (Million tonnes):

YEAR	1950	1960	1970	1980	1990	1999	2000	2001	2002	2003
	51	61	71	81	91	00	01	02	03	04
ON-SHORE	0.3	0.5	6.8	5.5	11.8	11.3	11.8	11.9	11.5	11.5
OF-SHORE	-	-	-	5.0	21.1	20.6	30.6	20.1	21.5	21.9
TOTAL	0.3	0.5	6.8	10.5	33.0	31.9	32.4	32.0	33.0	33.4

Table 26.5 Production of Petroleum (Crude) in India, 2002-03:

State/Area	Production ('000 tonnes)	Percentage of all India production	Value (Rs. crore)
MUMBAI H	21,573	65.28	12,016.16
GUJARAT	6,042	18.28	3,365.94
ASSAM	4,659	14.09	2,395.6
TAMIL .N	395	1.19	220.01
ANDHRA P	300	0.93	167.10

Petroleum Refining:

Oil extracted from the oil wells is in its crude form and contains many impurities. It is refined in oil refineries before use. After refining, various products such as kerosene, diesel, petrol, lubricants, bitumen, etc. are obtained. Although India's first oil refinery started working way back in 1901 at Digboi in Assam, it remained the only refinery in the whole of India for more than half a century.

It was only in 1954 that another refinery at Tarapur (Mumbai) joined the lone refinery of Digboi. Since then oil refining in India has progressed at a rapid pace. Today there are 19 refineries in the country, 17 in the public sector, one in joint sector and one in private sector. The installed refining capacity was only 0.3 million tonnes in 1950-51 which rose to 121.8 million metric tonnes in 2003-04.

Seventeen public sector refineries are located at Guwahati, Barauni, Koyali, Haldia, Mathura, Digboi, Panipat, Chennai, Narimanam, Bongaigaon, Mumbai (HPCL), Vishakhapatnam, Mumbai (BPCL), Kochi, Numaligarh, Tatipaka (ONGC) and Bina (M.P.) Bina refinery was inaugurated in June 2003. Aggregate refining capacity of these plants is 75.95 million tonnes per annum.

One refinery in joint sector is at Mangalore in Karnataka. It has refining capacity of 9.69 million tonnes per annum. Private sector refinery of Reliance Petroleum Limited was commissioned at Jamnagar in 2001. With an installed capacity of 27 million tonnes, it is the biggest refinery in the country. The existing and under construction/proposed refineries are shown in Fig. 26.6.

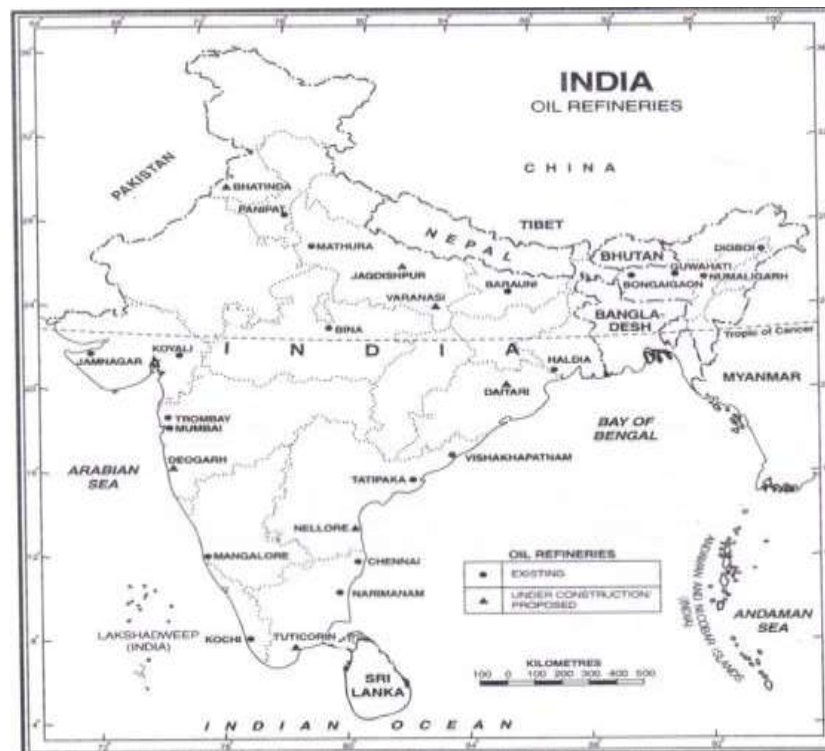


FIG. 26.6, India : Oil Refineries

Imports:

Consumption of oil and its products has always outstripped production in India. In 1950-51, India produced only 2.7 lakh tonnes of oil against consumption of 34 lakh tonnes. With the progress in industries and transport, need for oil has increased dramatically in the post-independent era. Consequently, India has to lean heavily on the imports of oil and its products.

It is clear from Table 26.6 that our oil bill has been rising rather disturbingly both in terms of quantity and value due to our increased demands for economic growth and because of rising prices of oil and oil products in the international market. Our oil import bill increased from less than 9 per cent of the total imports in 1960s to 30 per cent following the first oil crisis in 1973-74 and to 75 per cent in 1980s after the second oil crisis.

Decline in indigenous production during 1989-90 and 1993-94 further worsened the balance between production and consumption. In the year 2003-04, India imported 99,495 thousand tonnes petroleum, oil and lubricants against the home production of 33,043 thousand tonnes only. Thus our imports of oil were more than three times the indigenous production.

This puts serious strain on our foreign exchange reserves. With increase in growth of industries and transport, demand for oil will increase further and make things still worse. In 2003-04, our oil belt accounted for 28.7 per cent of the total imports.