NITROGEN FLOODING

Nitrogen flooding can be a viable EOR method if the following conditions exist in the candidate reservoir:

1. The reservoir oil must be rich in ethane through hexane (C_2-C_6) or lighter hydrocarbons. These crudes are characterized as "light oils" having an API gravity higher than 35 degrees.
2. The oil should have a high formation-volume factor – the capability of absorbing added gas under reservoir conditions.
3. The oil should be undersaturated or low in methane (C_1).
4. The reservoir should be at least 5,000 feet deep to withstand the high injection pressure (in excess of 5,000 psi) necessary for the oil to attain miscibility with nitrogen without fracturing the producing formation.

Gaseous nitrogen (N_2) is attractive for flooding this type of reservoir because it can be manufactured on site at less cost than other alternatives. Since it can be extracted from air by cryogenic separation, there is an unlimited source, and being completely inert it is noncorrosive. In general, when nitrogen is injected into a reservoir, it forms a miscible front by vaporizing some of the lighter components from the oil. This gas, now enriched to some extent, continues to move away from the injection wells, contacting new oil and vaporizing more components, thereby enriching itself still further. As this action continues, the leading edge of this gas front becomes so enriched that it goes into solution, or becomes miscible, with the reservoir oil. At this time, the interface between the oil and gas disappears, and the fluids blend as one.

Continued injection of nitrogen pushes the miscible front (which continually renews itself) through the reservoir, moving a bank of displaced oil toward production wells. Water slugs are injected alternately with the nitrogen to increase the sweep efficiency and oil recovery.

At the surface, the produced reservoir fluids may be separated, not only for the oil but also for natural gas liquids and injected nitrogen.

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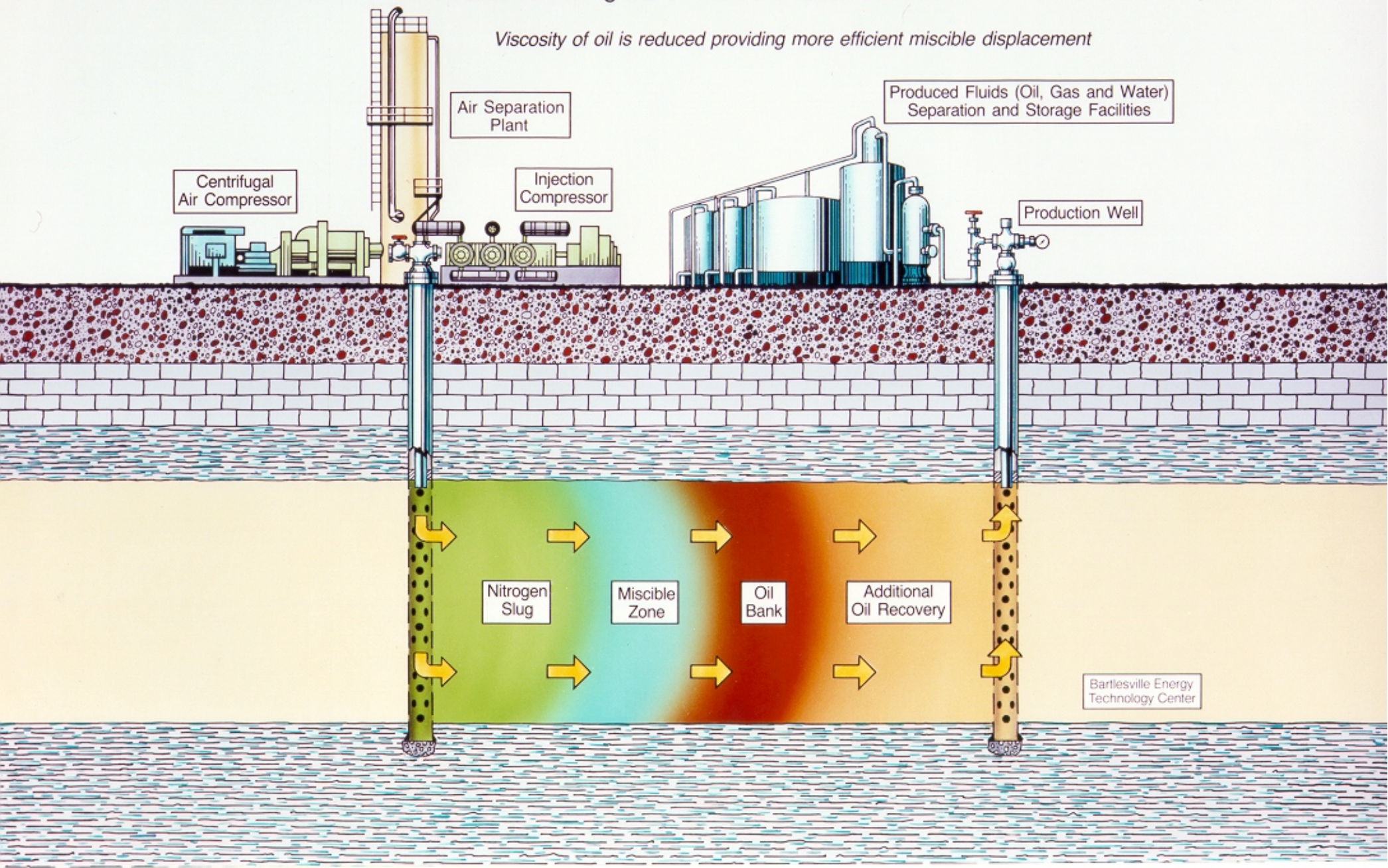
This method can be used as a substitute for CO_2 in deep reservoirs with high API gravity oil. When injected at high pressure, nitrogen can form a miscible slug which aids in freeing the oil from the reservoir rock.