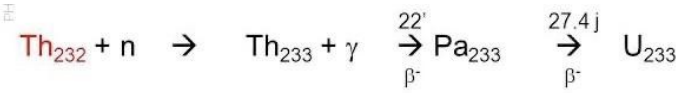
An Incredible Thorium Repository

Do you have a wanderlust in exploring incredible India!? Globetrotting in such a discrete and diversified land of India could be mind-boggling as each region of this country is demographically and culturally distinct. In the extreme north, stands the great Himalayas with head held high while on the southern end we have the Indian Ocean and Sri Lanka linked via the Palk Strait. The eastern and western parts are surrounded by spectacular sea beaches. Let's explore some of these tropical beaches of the west coast and their contribution to the Indian Nuclear Power Program.
The beach sands of Kerala have rich reserves of Monazite [$(Th,Ca,Ce)PO_4$)], a mineral ore containing 8-10% of nuclear grade Thorium (Th^{232}). Large abundance of Thorium forms the basis of the Indian nuclear power program. Being non-fissile (fertile), Th^{232} can't undergo fission and hence cannot be directly utilized to produce energy. It needs to be transmuted to fissile U^{233} upon absorbing a neutron within a reactor following the nuclear reaction as given below:



Nuclear grade Th^{232} is extracted as ThO_2(Thorium Oxide), which is also known as Thoria or mineralogically as Thorianite. Besides, Monazite also contains 60% of rare earth oxides, 0.4% of UO_2 and trace amounts of silica. Monazite forms the primary source of the world's Thorium production.

The approach to the three stage Nuclear Power Program was proposed by none other than the father of the Indian Nuclear Program, Dr. Homi Jehangir Bhaba. Initially, Pressurized Heavy Water Reactors (PHWR) are fed with natural uranium (UO_2) which mostly contains U^{238} and 0.7% of fissile U^{235} . The fissile portion is only utilized for power production and the remaining 99.3% U^{238} is utilized for generation of the byproduct Pu^{239}, which is fissile in nature. In PHWRs, heavy water is utilized both as moderator and coolant.
In the second stage, Fast Breeder Reactors (FBRs) are fueled with Pu^{239} in the form of mixed oxide (MOX) fuel. FBRs are designed to breed more fuel than they consume as they are capable of producing additional Pu^{239} as a result of transmutation of U^{238} present in the MOX fuel. As soon as the inventory of Pu^{239} is established, Thorium can be introduced as a blanket material in the reactor and transmuted to U^{233} to be utilized in the third stage. Besides involving U^{233} as fuel in stage III Thorium based breeder reactors, blanket of Th^{232} will also be present around the U^{233} reactor core for additional generation of U^{233} as the reactor goes operational leading to a self-sustaining Th^{232}-U^{233} nuclear reaction. Stage III reactors are still under development.

Besides Kerala, thorium deposits are also found in the Indian state of Orissa.

The beaches of the west coast of India are one of the most important sights for tourist attraction due to their jet black shade glittering beach sands containing minerals such as hornblende, magnetite, tungsten, titanium including thorium and many more. One such notable beach is the Kovalam beach of Kerala where mining of minerals takes place. So what's stopping you?!! Make your summer more happening and plan a sea-weekend to spend quality time on the black and beautiful beaches of Kerala (and witness the

famous backwaters as an add-on).

Kovalam Beach, Trivandrum, Kerala

References:

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