THE D-AND F-BLOCK ELEMENTS

INTRODUCTION OF D-BLOCK ELEMENTS

- **THE ACTINOIDS**

ACTINOIDS (5f - SERIES):

The actinoids include the fourteen elements from Th to Lr. The actinoids are radioactive elements and the earlier members have relatively long half-lives, the latter ones have half-life values ranging from a day to 3 minutes for lawrencium (Z =103).

Electronic Configuration: All the actinoids are believed to have the electronic configuration of $7s^2$ and variable occupancy of the 5f and 6d subshell. The fourteen electrons are formally added to 5f, though not in thorium (Z = 90) but from Pa onwards the 5f orbitals are complete at element 103. The irregularities in the electronic configuration of the actinoid, like those in the lanthanoids are related to the stabilities of the f°, f^7 and f^{14} occupancies of the 5f orbitals. Thus, the configurations of Am and Cm are [Rn] $5f^7\ 7s^2$ and [Rn] $5f^7 6d^1 7s^2$.

Ionic Sizes: The general trend in lanthanoids is observable in the actinoids as well. There is a gradual decrease in the size of atoms or M^{3+} ions across the series. This may be referred to as the actinoids contraction (like lanthanoids contraction). The contraction is, however, greater from elements to element in this series resulting from poor shielding by 5f electrons.

Oxidation states: There is a greater range of oxidation states, which is in part attributed to the fact that the 5f, 6d and 7s levels are of comparable energies.

The actinoids show in general +3 oxidation state. The elements, in the first half to the series frequently exhibit higher oxidation state. e.g., The maximum oxidation state increases from +4 in Th to +5, +6 and +7 respectively in Pa, U and Np but decreases in succeeding elements. The actinoids resemble the lanthanoids in having more compounds in +3 state than in the +4 state. However, +3 and +4 ions tend to hydrolyse.

GENERAL CHARACTERISTICS AND COMPARISION WITH LANTHANOIDS:

1. The actinoids metals are all silvery white in appearance but display a variety of structures. The structural variability is obtained due to irregularities in metallic radii which are far greater than in lanthanoids.
2. The actinoids are highly reactive metals, especially when divided, the action of boiling water on them, for example, gives a mixture of oxide and hydride and combination with most metals takes place at moderate temperatures; hydrochloric acid attacks all metals but most are slightly affected by nitric acid owing to the formation of protective oxide layers; alkalies have no action.
3. It is evident from the chemistry of lanthanoids that the ionisation enthalpies of the early actinoids, though not accurately known, but are lower than for the early lanthanoids. This is quite reasonable since it is to be expected that when 5f orbitals are beginning to be occupied, they will penetrate less into the inner core of electrons. The 5f electrons, will therefore, be more effectively shielded from the nuclear charge than the 4f electrons of the corresponding lanthanoids. Because the outer electrons are less firmly held, they are available for bonding in the actinoids.

Note: The lanthanoids contraction is more important because the chemistry of elements succeeding the actinoids are much less known at the present time.

USES OF ACTINOIDS:

1. Thorium is used in atomic reactors and in the treatment of cancer. Its salts are used in making incandescent gas mantles.
2. Uranium is used as a nuclear fuel. Its salts are used in glass industry (for imparting green colour), textile industry, ceramic industry and in medicines.
3. Plutonium it is used as a fuel for atomic reactors as well as for making atomic bombs.