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Wet blasting in conjunction with decommissioning

It's important to understand how contamination bonds to the surfaces and oxide in order to choose an effective method in order to decontaminate the components. The main reason to decontaminate components in nuclear power plants is to enable service or for **free release**. If the components after decontamination reach a radioactive level where it will be **declassified** it can be used freely outside the power plants. The level of radioactivity allowed on the components for free release is 40 kBq/m^2 in total of beta- and gamma nuclides and 4 kBq/m^2 of alpha nuclides in Sweden.

On steel surfaces in contact with the reactor water is a protective oxide layer formed. **The growth of the oxide** layer on the metal surfaces can be compared with an electrochemical process with metal/metal oxide layer as an anode and layer between the metal oxide and water as a cathode. Simplified the metal ions and electrons are transported out through the oxide and builds up the oxide from the outside. Continuously exchange of metal ions between the metal oxide surface and the water occur. Water with metal ions and corrosion particles is pumped close to the fuel rods and get exposed for intensive neutron radiation. By this thermal reaction with neutrons does for example the non-radioactive cobalt-isotope Co^{59} change state to the radioactive Co^{60}. **Co^{60} is clearly dominated** in the system from a radioactive point of view outside the reactor core together with the isotope Co^{58}. Most of the **radioactive corrosion** products stay in the reactor core but some small quantities find its way out in the system with the reactor water. The oxide layer is constantly growing in thickness which makes it more likely for radioactive particles and ions to get build into the oxide layer. This can happened either physically by absorptions forces on the oxide surface makes the corrosion particles stick to the surface and get build in by the growing oxide layer or chemically by co-crystallization and through ion exchange. It may also be integrated into the oxide by filling vacancies present in the oxide.

Activity is lower on cold system surfaces than on the hot surfaces because of the slower corrosion rate. The oxide layer is not as thick as on the hot system surfaces and the contamination has looser bonds to the oxide surface which makes it easier to decontaminate.

One effective **method to decontaminate** components is wet blasting with glass beads or alumina oxide for a more effective peeling i.e., when decommissioning. When compared with the other main options available, high pressure cleaning, electro polishing and chemical bating, wet blasting provides comparable or better decontamination factors leaving a derived waste easier to handle and store. Wet blasting is compared to other methods a fast way to decontaminate components. When wet blasting the beads are surrounded with a film of water, so at the moment of impact against the components works like a pressure-absorbing cushion. This prevents the beads from being in direct contact with the metal surface. The oxides on the metal surface blows away by the pressure shock by the water-cushions around the beads.

And in the aspect when it's time to decommission a plant where a huge systematic operation is needed, **safety is important** i.e. time exposed to active components. Wet blasting providing outer operator's position with proper radiation protection and more efficient blasting equipment results in a lesser dose taken by the operator.

As mentioned oxides on cold system parts is easier to strip with wet blasting, while on hot system parts it's tougher and it could be profitable to first put the decontaminated parts in a electrolyte bath with i.e. **Sodium sulfate** solution (5% Na_2SO_4), to crack the oxide layer to easier remove it with wet blasting afterwards.

Possible savings through wet blasting if equipment is used systematically in order to ensure that goods being sent for melting have an activity, which allows the ingots to be recycled within the 20-year period.

The contaminated waste from wet blasting is collected either in the water treatment plant or in the blasting media which makes it easy to handle and store. Examples of waste levels, by decontaminating 800 components in one year, results in a waste volume of about 0,250 m^3.

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