# New developments in the evaluation of spent fuel as a waste form.

KASTRIOT SPAHIU[1]

[1]SKB, Stockholm, kastriot.spahiu@skb.se

The dissolution rate of spent nuclear fuel depends on intrinsic factors such as fuel structure and burn-up, as well as environmental factors, including groundwater composition.

The burn-up of future spent fuel is expected to increase, which causes actinide accumulation in the rim zone and an increase of the content of lanthanides and other fission products in the $UO_2$ matrix. The formation of a high burn-up structure at the fuel rim is characterised by much smaller fuel grains and a large number of submicron fission gas bubbles, which both increase the surface area The increased actinide content in spent fuel at higher burn-ups leads to a higher $\alpha$-dose rate. The higher dose rates together with the increased surface area are expected to increase the dissolution rate. All available experimental results show that the presence of fission products like lanthanides and other dopants in the $UO_2$ matrix has an inhibiting effect on $UO_2$ dissolution. The increase of non uranium cation concentration at high burn-up seems to counteract effectively the influence of higher surface area and higher dose rates

The anoxic corrosion of massive iron containers considered in most deep disposal concepts produces large amounts of dissolved hydrogen in the groundwater. During the last decade, a large impact of dissolved hydrogen on the dissolution of the LWR or MOX fuel and $UO_2$(s) doped with $^{233}U$ or $^{238}Pu$ has been observed. In most spent fuel experiments carried out under hydrogen, a decrease in concentration of all redox sensitive nuclides originating from a pre-oxidized layer is observed. This and other experimental observations during the leaching of spent fuel or model systems (such as alpha doped $UO_2$) under reducing conditions will be discussed from the point of view of understanding the mechanism of the oxidative dissolution. A discussion of the relative importance of the oxidative versus the non-oxidative dissolution of the fuel matrix will also be given.