When a radionuclide (in particular with long-life) come in contact accidentally with the skin, he will be fixed strongly on the cornea coat and become a sort of storage from which he spread slowly and penetrate into the internal environment.

### Material and Method

1. **Adsorption Study of the Radioelement in the cornea coat**
   - On a 5 ml test tube, about 100 mg of strontium carbonate sample is weighed and dispersed in the radioelement solution with a known radioactivity A; the set are brought to a pH 7 by the addition of sodium. The quantity of radioactivity absorbed by the chips is determined according to the A radioactivity. If we suppose that the radioelement is fixed on the skin in a monodisperse form, the equation of that curve can be obtained (Géraud et al., 1996).
   - On the skin area, there is M possible places. Among the M possible places, n places are engaged by radioelements and (M – n) are still free. The adsorption equation is as following:
     
   \[
   \text{Occupied space} = \frac{n}{M} \times \text{Radioelement in solution}.
   \]

2. **Radioactive products**
   - Uranium 238 (\(\text{U}_{238}\)), uranyl nitrate alpha transmittor, Cesium 137 (\(\text{Cs}_{137}\)), cesium chloride: beta and gamma transmittor, Strontium 90 (\(\text{Sr}_{90}\)), strontium chloride (in equilibrium with Titanium 90, its counterpart): beta transmittor.

3. **Radioactive measurement**
   - Alpha spectrometry for \(\text{U}_{238}\), after the calcination and the deposit of the skin chips on an inox U25 cupel (Orate-Measurement).
   - Beta counting for the \(\text{Sr}_{90}\), after the deposit of the skin chips on the inox cupel in fact, the measured set is the complex \(\text{Sr}_{90}^{+} \cdot \text{Y}_{90}\).
   - Direct gamma spectrometry of the skin chips for the \(\text{Cs}_{137}\).

4. **Results**
   - **Rising of Cesium (C) with different solutions**
   - **Effectiveness of different cleansing solutions (decrease of the radioactivity in \%)**
     - Water: 19% - 53% - 59%
     - Diphosphate\(^{-}\): 56% - 71% - 59%
     - DTPA: 67% - 11% - 74%
   - **Rising of Strontium and Titanium (SNY) mix with different solutions**

5. **Discussion**

   - **Uranium**
     - The treatment of the uranum contamination is difficult and the water cleansing is not well effective because the radioelement is absorbed strongly in the skin. In fact, the uranum complex as the type \((\text{UO}_{2})_{2}^{2-}\) (OH\(^{-}\))\(2n\) is the one fixed, not the uranyl ion \(\text{UO}_{2}^{2-}\) monomeric space. We can consider the case no rinsing as the reference and compare the straight eight's slope for the effectiveness' comparison, we observe that the decreases of the radioactivity: 10%, 36% and 67% with water, Diphosphate\(^{-}\) and DTPA.
     - The highest the uranum concentration is, the biggest will be the polymer's weight.
     - This explains why the precision of the solution's concentration and the quantity kept by the skin. To realize a skin desorption, it is necessary to use a cleansing solution as DTPA (Géraud et al., 1996). Diphosphate\(^{-}\) can also realize the decontamination.
     - The effectiveness of these two products can be linked in one to their complexation properties and in the other hand to their compatibility properties. (Diphosphate\(^{-}\) and DTPA compatibility are respectively 1300 and 1800 millimoles).

   - **Cesium and Strontium**
     - The linking of these two radioelements are different from the uranum linking. The Cesium exists on its isomeric configuration he will fix himself on the skin bar over certain concentration, the all free places are occupied; the cornea coat are therefore saturated this is expressed by a plateau. The measurement of the Cesium's plateau height show that with water, Diphosphate\(^{-}\) and DTPA rinsing, we observe radioactivity decrease of 33%, 7% and 7% respectively.
     - The strontium also exist in its isomeric and monomeric form, but it is always followed by yttrium who by its hydrolysis in aqueous area, will generate polynuclear complex. If we consider the case without rinsing as the reference and compare the straight eight's slope for the effectiveness' comparison, there is not significant difference between water and Diphosphate\(^{-}\)'s cleansing and the radioactivity's decrease is around 30% in both cases. With DTPA we observe an important decrease (74%) of the radioactivity.
     - In both cases, water can realize the decontamination because of its existing ions in the solution as a isomeric monomeric configuration. Diphosphate\(^{-}\) and DTPA as rinsing solution, only provided a small advantage comparing to the water.

The uranium is fixed on the cornea coat of the skin while forming polymerized hydroxylated products. This link influence the percutaneous absorption. This dissolution is different from the one observed with cesium and strontium because cesium are fixed as isomeric monomeric configuration, the water did not realize a decontamination. We need specific products as 25% DTPA solution. Diphosphate\(^{-}\) as DTPA, but simpler and monomeric properties. Thanks to its amphetcetic action, Diphosphate\(^{-}\) can particularly be indicated for the treatment of contamination, often associated to chemical burns due to strong Acid containing radioelements for example.

Finally, in the cases of eyes contamination for which there is no treatment prescribed nowadays, Diphosphate\(^{-}\) appears as an essential element for the emergency treatment.

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**Table:** Cutaneous penetration of the three important families of radioelements

<table>
<thead>
<tr>
<th>Chemical family</th>
<th>Example of radioelements</th>
<th>In &amp; h Penetration according to the % of uncoupled activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition element (actinide)</td>
<td>Plutonium (Pu-239) Uranium (U-238, U-235)</td>
<td>0.01</td>
</tr>
<tr>
<td>Alkaline</td>
<td>Cesium (Cs-137)</td>
<td>3</td>
</tr>
<tr>
<td>Alkaline earth metals</td>
<td>Strontium (Sr-90)</td>
<td>0.37</td>
</tr>
</tbody>
</table>