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### Question 2.3

What maintenance challenges exist for alternative technologies, especially for demanding applications? Is there any significant difference from the maintenance challenges for conventional oil-immersed transformers?

### Answer

Basically, the maintenance and surveillance practices of ester-immersed transformers are like that of oil-immersed transformers.

Sometimes more frequent controls are planned but this is due to the, so far, limited experience which induces the owners to be very prudent. Of course, the traditional practices based on mineral oil must be reconsidered due to higher permittivity of the esters and high value of DDF comparing to mineral oils. A lower value of liquid resistivity and transformer resistance should be expected without jeopardizing the transformer reliability.

Since natural esters is recommended for hermetic sealed equipment (no-breathing) only, usually the reconditioning and the reclaiming process for restoring some chemical parameters (water content, total gas content, acidity, DDF, IFT, etc.) are not necessary for the entire transformer life.

For best utilization of ester liquids performance, they may be combined with aramid insulation. This allows for higher temperature operation and may further reduce the footprint of the transformer by reducing its size. Use of aramid insulation eliminates water generation from degrading cellulose; hence, further eliminates need for liquid reconditioning.

If treatment was needed, the regular oil treatment equipment can be used after complete rinsing with ester in order to remove residuals of mineral oil. Due to higher viscosity of natural ester, ideally, in a new treatment system the vacuum unit should preferably be realized with a rotary pump and a Roots pump to compensate the flow loss typical of volumetric vacuum pumps at low pressure values (< 50 mbar).

Lastly the existing DGA interpretation criterion for natural esters are very rudimental and they need some implementation. For this reason, CIGRE JWG D1/A2.77 and IEC TC10 MT45 are working together for improving this technique.