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E.5. Résultats d'essais en tension continue sur des câbles à isolation polyéthylène basse densité

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Résumé :

Actuellement, seule l'isolation au papier imprégné est utilisée pour les câbles à haute tension continue, et ce au détriment des isolations synthétiques.

Afin de mieux connaître le comportement des isolations synthétiques sous champ continu, nous avons engagé des travaux qui ont conduit au choix du polyéthylène basse densité (PEBD) pour l'isolation principale, et à la mise en essais de longue durée de systèmes complets : câbles, jonctions moulées et extrémités synthétiques, dimensionnés pour une tension de service de 270 kV. Nous présentons ici les points marquants concernant ces essais.

En conclusion, la technologie est adaptée au niveau 300 kV ; compte tenu de l'expérience acquise, la mise au point d'un système 400 kV (continu) dimensionné pour un champ électrique moyen de 20 kV/mm ne devrait pas poser de problèmes particuliers.

1-FOREWORD

Synthetic insulation cables have been successfully developped for the transportation of energy under extra high alternating voltage ; this leads electric utilities to generalize this type of insulation inside their grid. Nevertheless, paper insulations (either solid type or OF) are still compulsory for cable links under high direct voltage [4], for two main reasons :

-the unsufficient knowledge of the synthetic insulation's behaviour under a DC stress. In particular, a space charge may build up and disturb the electric field distribution inside the insulation and lead to local overstresses, unsuitable to long-run ability,
-a restricted market, dominated by paper insulations, that fit in satisfactorily with the needs. Thus, the profitability of the investments required to develop synthetic insulation HVDC cables is not prooved.

And yet, the technological advantages of synthetic insulated cables are clear : they are almost maintenance free, lighter and they have a smaller thermal resistance between the conductor and without, for given voltage and conductor cross section.
That's why we conducted studies on the behaviour of synthetic insulations under a direct electrical field.

2-TESTS ON FILMS AND ON SCALED DOWN CABLES

After some theoretical studies during the 1970's, followed by tests on films, tests on scaled down cables have been performed in the beginning of the 1980's.

E.5. Results of tests using continuous high voltage on low density polyethylene insulation

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Abstract :

So far, the transmission of energy under direct voltage has been achieved with paper insulated cables to the prejudice of synthetic insulated cables.

So as to better understand the behaviour of synthetic insulations under a direct electric field, we conducted studies and tests that led to the choice of low density polythene (LDPE) for the main insulation ; then, we conducted tests on complete systems : cables, joints and terminations, sized for a service voltage of 270 kV. The features of the tested systems are described and the main results of the tests are pointed out in the paper.

As a conclusion, this technology suits the 300 kV level. With regard to the acquired knowledge, the 400 kV level (DC) should not raise particular points, with an average stress sizing of 20 kV/mm for the main insulation.

2-1 SPACE CHARGE MEASUREMENT

Figure 1 shows the result of a space charge measurement in a scaled down cable (5 mm radius on the conductor insulated by 7 mm of LDPE), after 8400 hours under -260 kV, including heating cycles.
The space charge was measured with the pressure wave method [3].

Generally speaking, these space charge measurements show that the space charge stays in the vicinity of the electrodes, and that it is an electronic charge ; the charge is important at the interface between the semi-conducting layers and the insulation, where charges are injected from the electrodes.

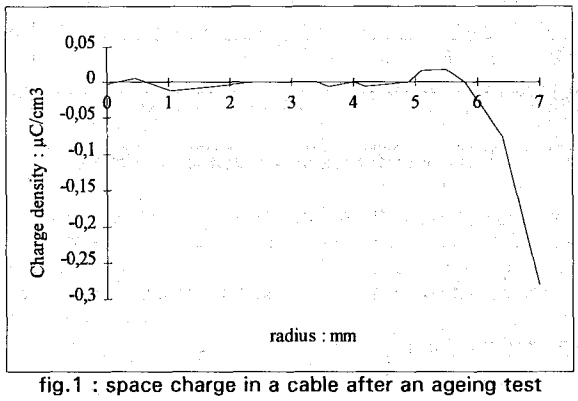

fig.1 : space charge in a cable after an ageing test