5.4.5 COMPRESSIVE STRENGTH (figures 13 and 14)

The compressive strength values of the irradiated concrete samples are slightly less than those of the control samples stored at the same temperature. The compressive strength of the irradiated concrete samples would appear to decrease slightly as a function of the dose. Likewise with the thermal cycles in the order of 200 °C, irradiation at this temperature has the effect of increasing the compressive strength of the serpentine samples. However, in the case of high irradiation doses and after six months under heat, the irradiated samples are less resistant than the control samples stored at a temperature.

The compressive strengths of the irradiated pure cement paste samples are not very different from the compressive strengths of the control samples. Yet the results obtained on irradiated samples are very scattered. Hence it is difficult to show that irradiation has any effect on the compressive strength of this type of concrete. It may be initially assumed that this effect is insignificant.

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CONCLUSION

Irradiation at integrated fluxes of 2×10^{19} to 10^{20} $n.cm^{-2}$ of energy above 1 Mev and at temperatures in the order of 200 °C, damages serpentine granulate concrete bound by aluminous cement. The effect of irradiation results in expansion of the material which reaches 7000μ/m at the dose of 10^{20} $n.cm^{-2}$ This is mainly due to the expansion of the serpentine granulates under irradiation, but also presumably to micro-cracking caused by the various deformations of the components, serpentine and pure cement paste, since it skrinks under the effect of irradiation (this shrinkage is incidentally of the same order of magnitude as that brought about by thermal treatment at 200 °C.)

The mechanical properties of the concrete are also altered by neutron irradiation:

- bending strengths diminish as a function of the irradiation dose and the dynamic elastic modulus does likewise. The greatest damage appears at the start of irradiation for doses in the order of 3×10^{19} $n.cm^{-2}$.
- compressive strengths diminish slightly or remain of the same order as those measured ex irradiation, after thermal cycling of the concrete. They remain in the order of 400 bars, which is an adequate value for shielding concrete.

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Furthermore, irradiation does not alter the "constitutive water" content of serpentine. At the irradiation temperature (200 °C), the weight losses of the samples are only due to dehydration of the pure cement paste.

The results of these irradiations together with those that were obtained with other irradiations show that neutron irradiation always brings about dimensional changes in the materials studied. In general this is expansion. Yet shrinkage had already been observed during an experiment carried out on an insulating concrete made of expanded clay granulates and vilmolithe bound by aluminous cement. Hence it was thought that these dimensional changes were due to the granulates. This assumption is confirmed by the results relative to serpentine concrete. The granulate plays a leading part in the dimensional behavious of concrete under irradiation.

Similarly, changes in the mechanical properties of concrete as a result of neutron irradiation are strongly affected by the evolution in the mechanical properties of the granulate under irradiation.

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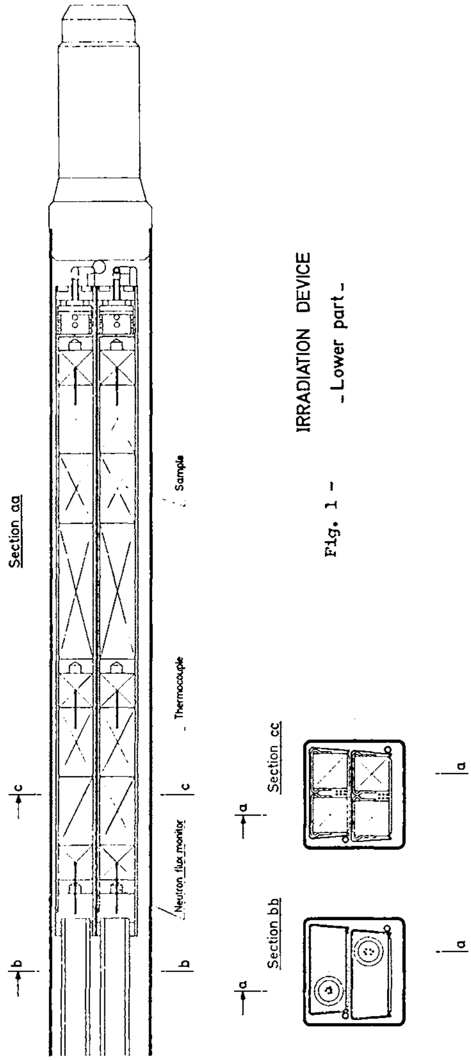

Fig. 1 - IRRADIATION DEVICE - Lower part -

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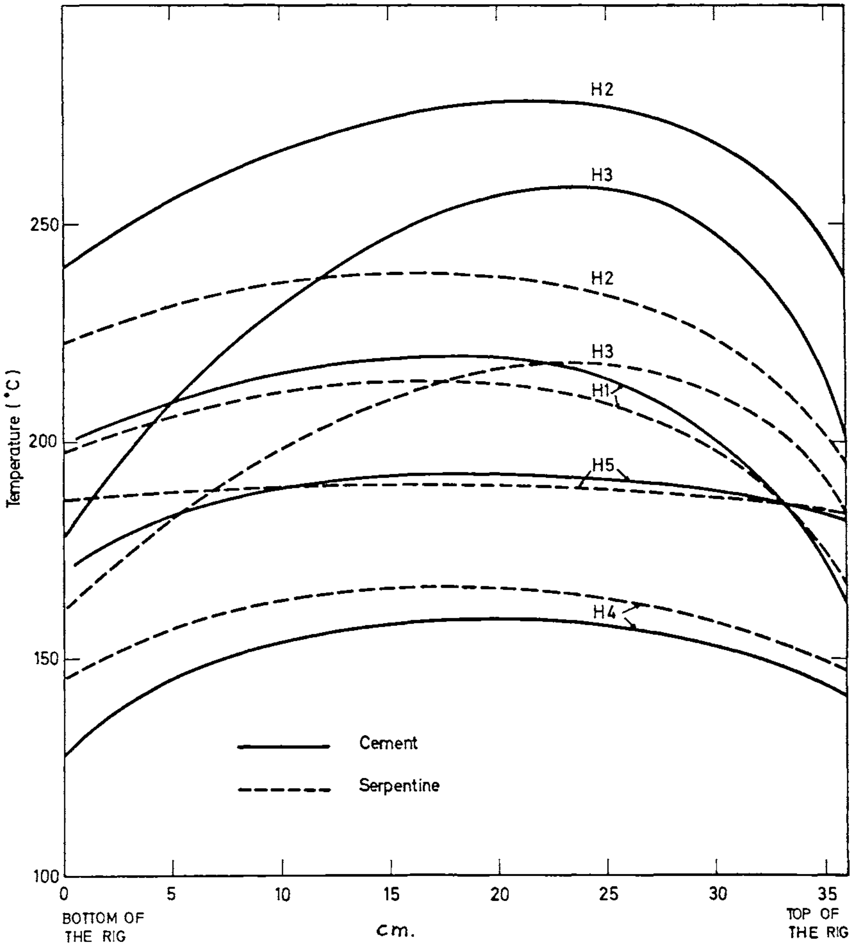

Fig. 2 _ Temperature distribution in the samples during irradiation for serpentine and cement paste

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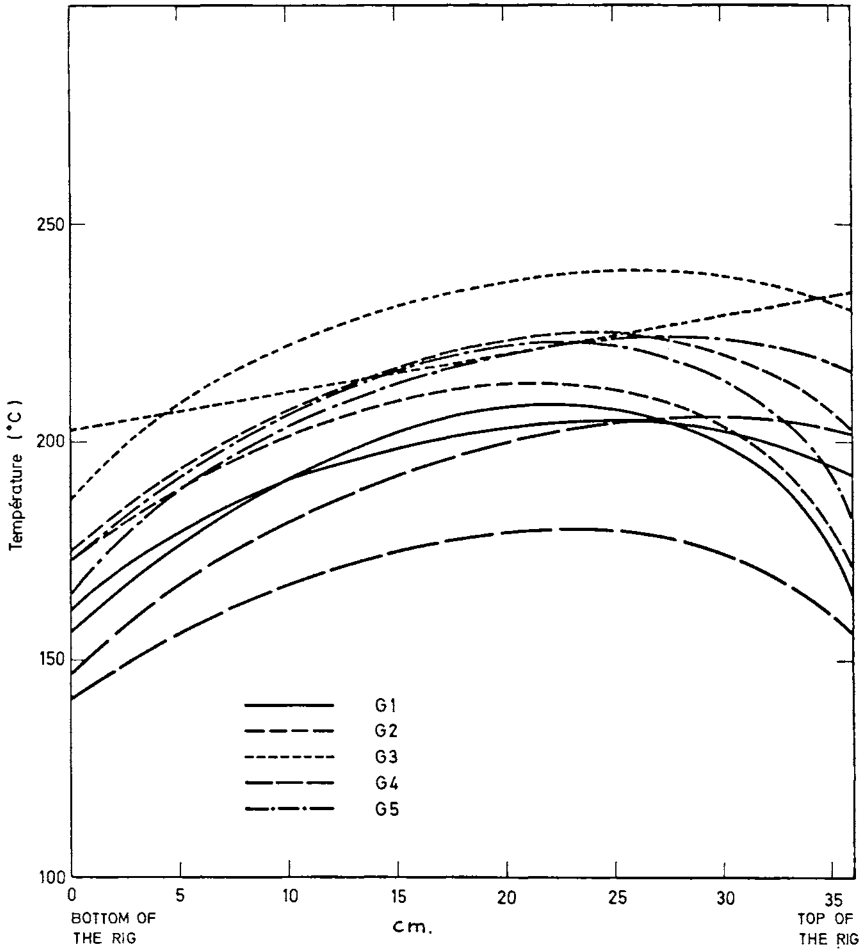

Fig. 3 – Temperature distribution in the samples during irradiation for concrete

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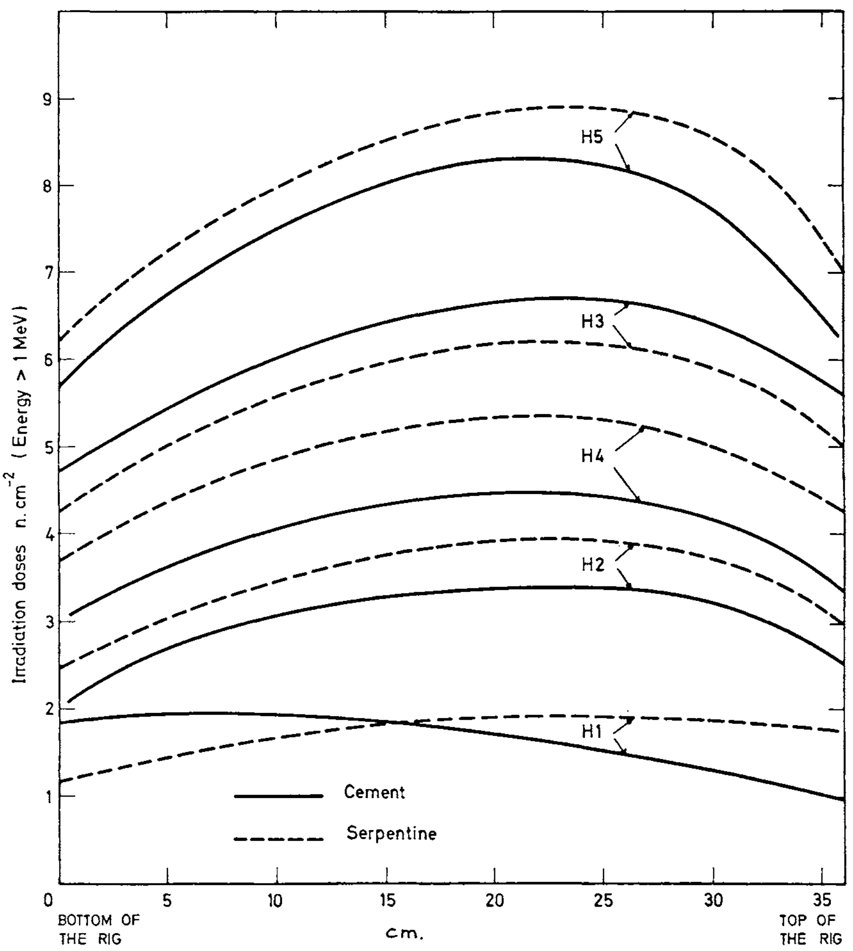

Fig. 4 _ Distribution of irradiation doses (fast flux) received by the samples for cement and serpentine

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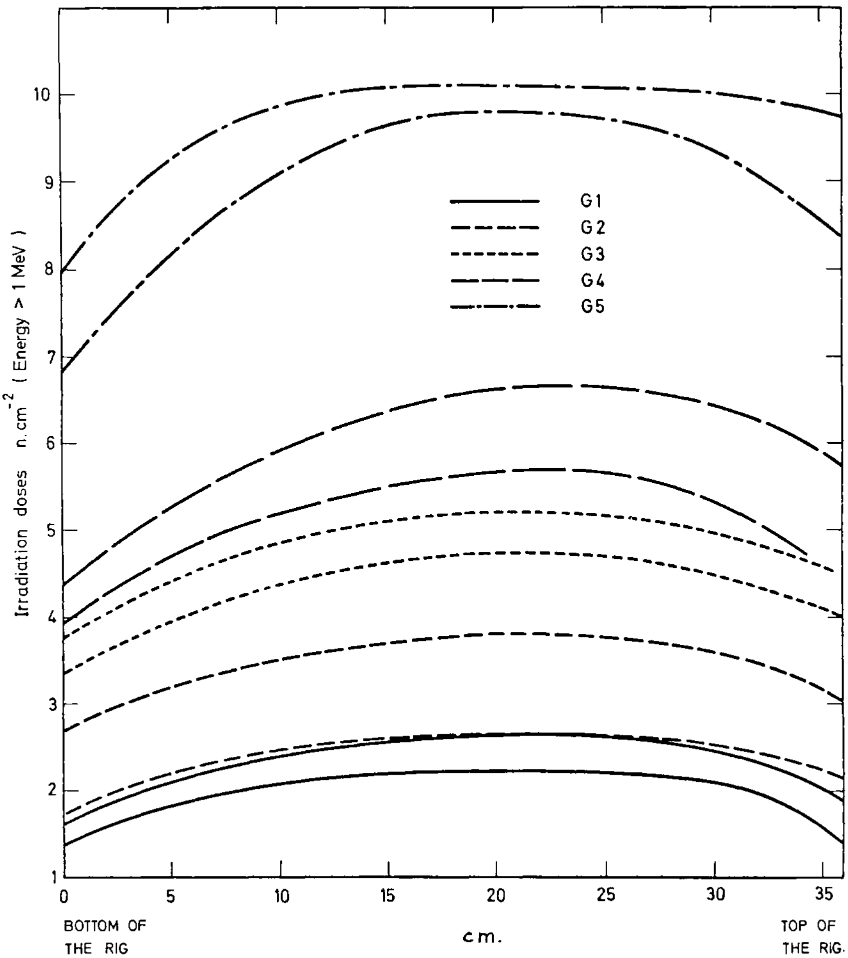

Fig. 5 _ Distribution of irradiation doses (fast flux) received by the samples for concrete

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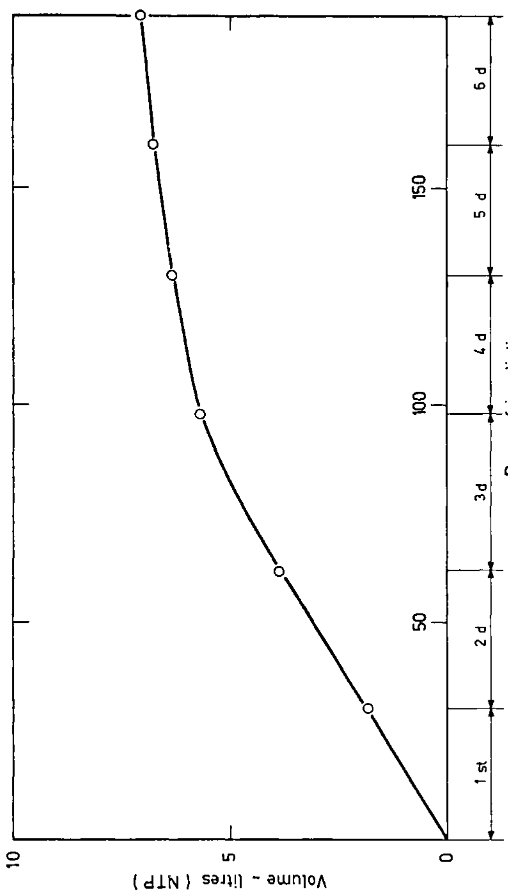

Fig. 6 – Evolution curve of the gas generated by the concrete during the G5 irradiation

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