correct processing will occur. The proportion of yeast genes that function when cloned in *E. coli* is surprisingly high, suggesting that, unlike higher organisms, many, or indeed most, are not 'split'. If they are expressed, then for some, at least, the complementation of yeast mutants may constitute a painless means of their isolation. □

France leads in vitrification of radiowastes

from Robert W. Cahn

It has been clear for more than a decade that the most acceptable known way to store highly radioactive wastes over the long term is to incorporate them in glass blocks which are then buried (the 'vitrification' process). The recent proposal, made severally by Ringwood in Australia and Roy in America, to incorporate wastes in synthetic rock may prove one day to be an acceptable alternative. Whichever (glass or 'synroc') wins greater acceptance in due course, such blocks will eventually need to be buried in appropriate geological formations, and a very extensive, systematic assessment of such formations in the UK is now in progress (Chapman, Gray & Mather *Atom*, No. 261, 185, July 1978.

A captious critic might comment that large-scale vitrification has been a gleam in the eyes of a number of scientific fathers for a long time, but that conception does not seem to be followed by gestation let alone parturition; meanwhile, concentrated radioactive solutions are fast accumulating. All the more credit, therefore, to the French Atomic Energy Commission which on 26 June this year inaugurated a production facility at Marcoule, in the Rhone Valley, to vitrify all the waste currently reprocessed at Marcoule, in addition to dealing with accumulated liquid wastes over the next 10 years.

An account of the investigations which preceded this event was given by E. Sombret on 28 June at a colloquium held at Saclay, the French nuclear research centre. All research has been concentrated on aluminoborosilicate glasses based on SiO_2, B_2O_3 and Al_2O_3, and a considerable range of compositions has been assessed. The proportion of solid waste incorporated in the glass depends upon the reactor type from which the spent fuel came; light-water reactor wastes, for instance, make up 24% by weight of the glass, and this implies a volume reduction by a factor of 7.5 times from the original aqueous concentrate, itself of course less voluminous than the original fuel before reprocessing. (A current Swedish programme, outlined in *Swedish Nuclear News* for June 1978, to encapsulate entire spent fuel elements in highly impermeable artificial sapphire by means of a high pressure technique at which the Swedes are adept, will be favoured by opponents of reprocessing, but implies very large volumes for subterranean storage.)

Extensive long-term tests were carried out on the stability of the glass blocks towards leaching by water at ambient temperature. The leaching rate stabilised after a month, at a rate which (to judge from figures quoted by Sombret) would be equivalent to the release of about one μCi of activity per day from a 2 kg block containing some hundreds of curies of activity. Large doses of β-radiation did not measurably affect this rate of leaching. Thermal stability was also tested: devitrification takes place at measurable rates above ~ 600 °C. Partially devitrified glasses did not leach faster than fully vitreous blocks.

To test the possible effects of α-radiation and concomitant injection of helium into the blocks, glasses artificially enriched in the actinides Pu, Am and Cm were made up and tested over a prolonged period. No detectable changes in mechanical properties were encountered, neither was the leaching rate increased. This finding is important because actinides are much longer-lived than the fission products. A further programme of research on the effects of the presence of α-emitters is to be initiated.

In designing optimum glass compositions, several mutually conflicting requirements—ease of melting, ability to dissolve in the glassy structure all the fission products and actinides from a particular reactor type—led to a range of different compositions for the various types of waste. On present indications, based on over 10 years of investigation, the stability of these glasses appears very satisfactory (even if a recent commercial advertisement, offering glass-melting furnaces for sale, guarantees the stability of the firm's glasses for a million years, is perhaps a little ingenuous. Which executive will undertake to be around in 1,001,978 AD to make good the guarantee?)

From 1969 to 1973, the French CEA operated a batch vitrification plant at Marcoule, and prepared 12 tonnes of glass with up to 3000 Ci l^{-1} of glass. Powdered glass stock and a stream of radioactive solution were slowly melted together and blocks then cast. A large-scale continuous plant, the AVM, was designed on the basis of satisfactory results with the batch plant. The cast blocks are to be force-cooled by circulating air for some years; thereafter, activity will have sufficiently decayed for cooling by natural convection to suffice (and at this point the blocks will be ready for geological disposal). Even if forced ventilation should break down, the research results indicate that leaching of the blocks will not be unacceptably accelerated. A further plant for La Hague is planned to be ready in 1982/3, sufficient to vitrify all current wastes from French light-water nuclear power stations.

The 1978 CEA Report claims that French experience in this field is encountering great foreign interest and expresses the hope that the technology will be internationally adopted.

It is conceivable that further improvements may stem from current research on the dense glasses used for the windows of remote-handling cells. In a recent publication of the German glass-maker, Schott, the role of ceria additions of 0.5–2.0% in stabilising such glasses against progressive loss of transparency is outlined. This form of stabilisation might have implications for enhancing the stability of vitrified wastes to chemical changes well below the devitrification temperature. □

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The ribosome: still a knotty problem

from Knud H. Nierhaus

Ribosomology has come a long way since the first EMBO worshop 10 years ago when even the number of components of the *Escherichia coli* ribosome had not been settled. Now, a rapidly increasing body of knowledge of the primary structure of ribosomal proteins and RNA means that the ribosome will be the first organelle of which the total sequences of its components will be known in the foreseeable future.

Recent developments in the rapid sequencing of nucleic acids in particular have stimulated a sequence explosion. The complete sequence of the 16S RNA was shown by H. Noller (University of California, Santa Cruz), which is an improvement in many details over the sequence data of the Strasbourg group. Y. Kaziro (University of Tokyo) compared the primary sequence of a part of the elongation factor EF-Tu, derived from the DNA sequence of the *tufA* gene on the one

*The sixth EMBO workshop on ribosomes, organised by D. Vázquez (Madrid), took place in Salamanca, Spain, on 26 June–1 July, 1978.

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