Author's reply to discussion

Solvent loading:

It is agreed that it is advantageous, as far as reagent cost is concerned, to operate at maximum solvent loading. However, owing to the fact that no reliable automatic solvent flow controller is yet available, control tends to be erratic with the result that there is risk of losing uranium. As can be seen from Mr Tunley's plot, the graph representing total ammonia cost is fairly flat between loadings of 3.5 and 4.0 gpl, while the graph representing uranium loss in the raffinate is steep. It is, therefore, safer to operate slightly below optimum loading in the absence of absolute control.

Should the purity of the final product gain importance, operation at optimum loading or even slightly above, may be advantageous.

Solvent losses and clarification of pregnant solution:

The cost of replacing solvent, as indicated by Mr Carman, represents a high percentage of the overall Purlex costs. It is, therefore, agreed that, amongst other factors, efficient clarification of the pregnant solution and mixer-settler design have an important bearing on the cost. However, as at Blyvooruitzicht, the Buffelsfontein plant can tolerate a suspended solids content of 50 ppm without serious deterioration in efficiency. An increase in the suspended solids content from 15 to 50 ppm normally accounts for an increase of approximately 1 ppm in amine loss.

Clarification of acidic pregnant solutions is much more difficult than that of alkaline solutions. Sand clarifiers are being used at Buffelsfontein with moderate success. Clarified solutions containing less than 20 ppm of solids in suspension can be produced, depending on the quantity and type of flocculant used in the filtration process, the thickness and the grading analysis of the sand beds and the quality of supervision. An on-stream duty of approximately 0.15 gallon per sq ft of surface area is obtained.

Hydraulic handling of clarifier sand, while cleaning, may effect the efficiency of a clarifier, as size segregation of sand particles may lead to inefficient "pockets" in a sand bed.

Control of the solution level in the sand clarifier also affects the quality of the effluent. Exposure of the sand bed invariably causes a cloudy effluent. Recycling of the final and initial solution discharged before and after skimming the clarifier sand improves the clarification efficiency significantly.

Post-precipitation of silica and possibly sulphate salts, after clarification, may give a false impression of inefficient clarification. This phenomenon is more pronounced when treating hot supersaturated solutions. Ageing and cooling of the solution before clarification assist in stabilising the solution and reduce precipitation after clarification.

The maintenance cost of sand clarifiers at Buffelsfontein is in the order of 0.35 cent per metric ton of solution treated.

A redundant ion-exchange column has been tested successfully, either as a primary or a secondary clarifier, depending on the quality of the filtrate treated. The conventional pebble and sand beds in the column have been retained. Operation was enhanced by the addition of a two-foot deep resin bed as a filtering medium. The suspended solids content was reduced to less than 5 ppm.

Mixer-settlers:

Mixer-settler design is a controversial subject but, in view of the high costs of solvent compared to relatively low pumping costs, it is believed that mixing and pumping functions should be separated. Separate facilities for pumping and mixing not only give greater operational flexibility but also permit eventual changes in the flow circuit as technology develops.

Scrub technique:

Unlike the pilot plant, where the crud was carried away in the aqueous phase, crud is carried over with the organic phase in the full-scale plant. This carry-over of crud into the strip bank aggravates crud formation in the first strip stage. This phenomenon may result from a slight difference in settler design and/or a variation in the relative phase depths in the two plants.

Bypassing of the scrub aqueous solution from the fourth to the second stage was introduced in order to avoid dilution and partial neutralisation of the acid added to the third stage, as it is known that a low pH value enhances the transfer of iron into the aqueous phase.

The low aqueous flowrate in the third scrubbing stage was overcome by introducing an aqueous phase recycle.

Gleaning:

Mr MacDonald's contribution on "gleaning" was most informative. This process for recovering solvent from raffinate seems to show at least as much promise as coalescers and other methods employed to date.

Similar tests conducted at Buffelsfontein pilot plant gave 60 per cent amine recovery from raffinate containing 10 ppm amine. However, the circuit was not operated at equilibrium and recovery may be expected to drop as the amine concentration of the "Gleaner" circuit increases.