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SCOPE OF THE RAW MATERIALS COST EVALUATION STUDIES

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PILOT PLANT SECTION
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SCOPE OF THE RAW MATERIALS COST EVALUATION STUDIES

FOREWORD

A part of the raw materials program of the Oak Ridge National Laboratory has been concerned for several years with an investigation and evaluation of different reagents to extract uranium from the aqueous solutions that are encountered in the processing of uranium ores.* As a result of these studies a number of possible flow sheets have been defined for the recovery of uranium by solvent extraction. These proposed processes, if they are to be considered for plant use, must be tested and proved on a pilot scale. To accomplish this, a raw materials process testing program was initiated at ORNL in 1954 to provide engineering studies which have the following objectives: (1) to establish the technical feasibility of the various uranium recovery processes, (2) to provide the additional chemical and engineering data that are available only from larger-scale continuous operations, (3) to provide design information for building new uranium mills based on solvent extraction techniques or for installing such facilities in existing plants, and (4) to prepare cost estimates for the purpose of comparing proposed process costs with those for other uranium recovery processes.

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*Uranium Chemistry of Raw Materials Section; K. B. Brown, Supervisor.

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The preparation of cost estimates is a necessary and very vital part of the process testing program since the engineering studies and the laboratory process development work can then be guided into the most advantageous channels. During 1954, cost estimating was carried on to a limited extent with the personnel assigned to the process testing work. In January, 1955, additional personnel were assigned to a raw materials economic studies program. This report outlines the scope of the cost estimating program for the immediate future and it describes the method to be employed in making the estimates so that the costs of various processes may be compared on the same basis.

INTRODUCTION

The costs associated with purchasing or mining the ore, its storage, crushing, sampling, grinding and leaching are common to all extraction processes; therefore, the starting point for the cost estimates made here is the slurry leaving the leach tanks. From this point on the costs of the processing steps will be computed separately for each of the several different processes that are shown in Fig. 1 so that the recovery costs may be compared on the same basis. For example, the cost of uranium recovered by a process that is designed to extract uranium from a slurry direct from the leach tanks is the sum of the extraction costs (D, Fig. 1) and the calcining and packaging costs (L). These costs may be compared to the recovery costs of a process that is designed to extract uranium from a clarified leach liquor which is the sum of the costs represented by segments B, F, and K.

Each of the extraction estimates will cover the processing costs starting with the head tanks, which hold a supply of feed to the process, and end with wet precipitated cake from the product slurry filters. The cost estimates will be made in accordance with the recommendations contained in Suggested Procedure for Economic Evaluation for Uranium Recovery Plants, prepared by the Processing Division of the Grand Junction Operations Office. It should be noted that,

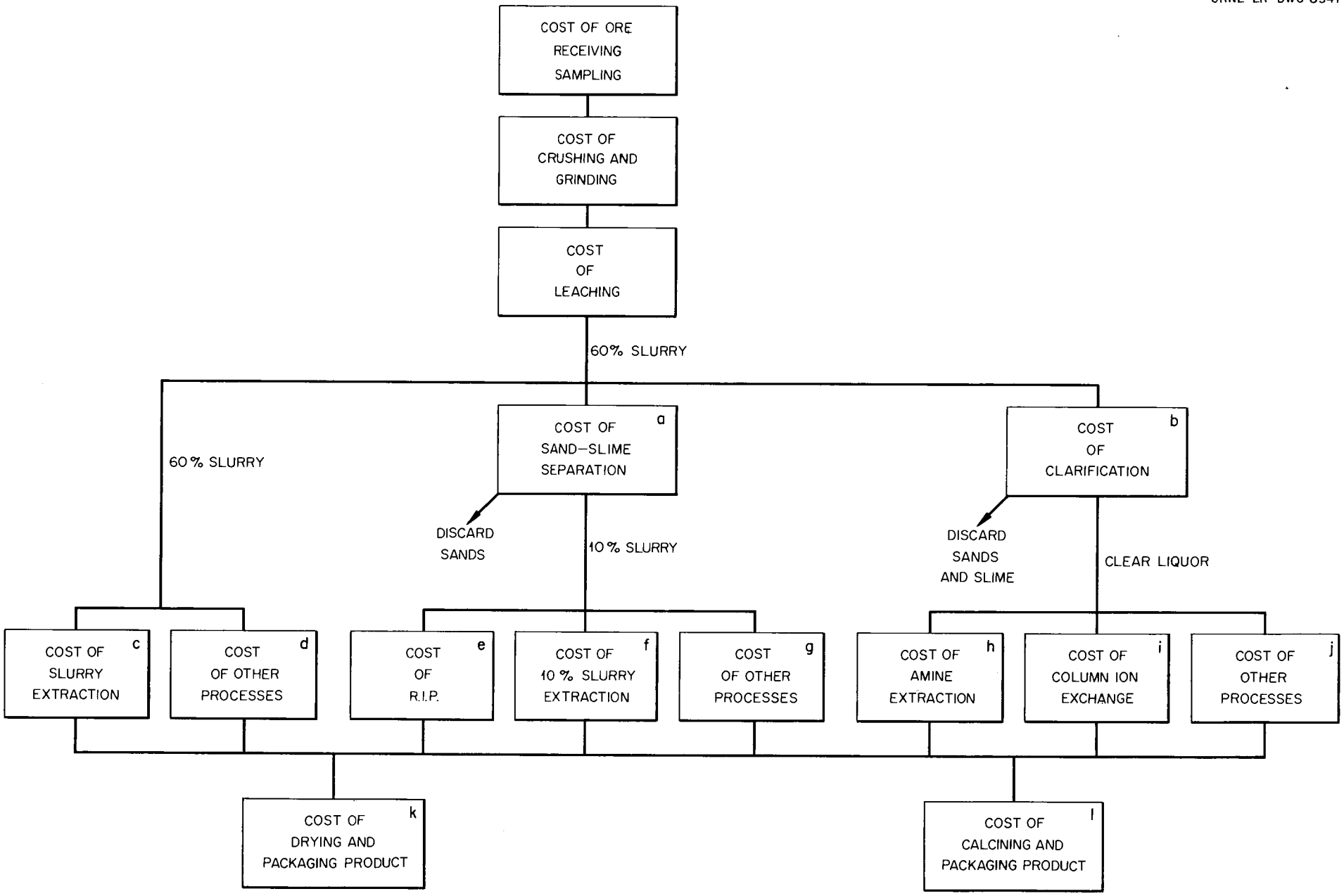

Fig. 1. Diagram Showing the Relationship Between Cost Estimates of Various Steps in the Recovery Processes for Several Methods of Uranium Recovery.

in presenting costs in the manner described, only depreciation and direct costs are to be included. Also a breakdown of maintenance and operating labor by grade is impractical; therefore, an average wage rate of $18.00 per man shift will be used.

CRITERIA

The criteria that are common to all estimates are listed below.

(a) The plant will be sized to process the streams resulting from the treatment of 200 tons of ore per day.

(b) The ore is assumed to assay an average of 0.3% U_3O_8 (6 lbs U_3O_8 per ton of ore).

(c) The ore is assumed to consist of 30 percent slimes and 70% sands.

(d) It is assumed that the ore is leached with sulfuric acid.

(e) The slurry resulting from the leaching operation is assumed to contain 60% solids.

(f) The 60% solids leach slurry will contain 95% of the original uranium in solution.

(g) The 10% slurry from the sand-slime separation step (Fig. 1, A) will contain 94.5% of the original uranium in solution.

(h) The clarified leach liquor (Fig. 1, B) will contain 94% of the original uranium.

(i) The clarified leach liquor will be equal in weight to twice the weight of the ore input, or 400 tons per day.

COSTS

The items to be included in the construction costs are listed in Table 1; those to be included in total operating costs are listed in Table 2. The steps involved in computing segmental costs are shown in Table 3 in which the costs will be presented as dollars per ton of ore and per pound of U_3O_8.

TABLE 1. CONSTRUCTION COST OF PROCESS FACILITY

A. Direct Construction Costs

1. Installed equipment including insulation _____
2. Process buildings _____
3. Process piping including insulation _____
4. Instrumentation _____
5. Electrical wiring including power, lights, and instrument wiring _____
6. Painting and scaffolding _____
7. Footings and foundations _____
8. Freight and handling _____

Total Direct Construction Cost _____

B. Engineering and Field Expense (10% of A) _____

C. Contingency [10% of (A plus B)] _____

D. Contractor's fee and overhead [10% of (A plus B plus C)] _____

Total Construction Cost of Process Facility (A plus B plus C plus D) _____

TABLE 2. DIRECT OPERATING COST

A. Labor Cost

1. Operating _____
2. Maintenance _____

B. Cost of Supplies

1. Operating
   - (a) Reagents and chemicals _____
   - (b) Fuel _____
   - (c) Other operating _____
2. Maintenance

C. Cost of Utilities

1. Electricity _____
2. Steam _____

Direct Operating Cost (A plus B plus C) _____

TABLE 3. ESTIMATED RECOVERY COSTS

A. Direct Operating Costs (Table 2) _____

B. Amortization of Construction Cost _____
(based on Table 1)

Total Recovery Costs (A plus B) _____