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AEC RESEARCH AND DEVELOPMENT REPORT

Y-1599

Instruments

MASTER

AN IMPROVED APPARATUS FOR
THE ELECTRODEPOSITION OF
URANIUM FROM URINE

L. D. Brown
W. T. McBryde

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE Y-12 PLANT

operated for the ATOMIC ENERGY COMMISSION under U. S. GOVERNMENT Contract W-7405 eng 26

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ABSTRACT

An apparatus is now in use that has improved the electrodeposition efficiency for recovering uranium from urine by 100 percent (from 40 to 80%). Also, the electroplating time has been reduced by 50 percent (from 60 to 30 minutes). Operation of the equipment is now fully automated following the addition of the urine solution to the electrodeposition cells and the application of power.

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SUMMARY

A significant improvement has been made to the electrodeposition apparatus used as part of the procedure for analyzing urine for its enriched uranium content. As a result of this modification, the plating time has been reduced to half its previous length, the plating efficiency has been doubled, and the cost per analysis has been lowered.

These improvements have been achieved largely because it is now possible to keep the cell solution at a constant temperature because a constant current flows throughout the entire plating cycle under a constant voltage.

An automated positioning device adjusts the anode within each cell to maintain the constant electroplating current. A constant voltage is maintained by a fixed, 50-volt DC power supply.

INTRODUCTION

For many years, urinalysis for enriched uranium has been accomplished at Y-12 by electrodepositing the uranium on 3/4-inch-diameter by 0.002-inch-thick silver discs, then determining the uranium concentration by measuring the alpha count of the electrodeposited uranium. The cell current of the electrodeposition apparatus was controlled by ballast-type regulators connected in series with the cell; the voltage was manually controlled by a rheostat located in the transformer primary of the DC power supply. The plating time for this procedure was one hour; the recovery efficiency was 40 percent.

It was believed that the plating efficiency could be increased and the plating time reduced if the current and voltage could be held constant, since a constant wattage dissipation in the electrolytic cell would produce a more uniform temperature. Until the improvements described in this report were incorporated into the equipment, the plating cells required constant attention by the operator in order to try to maintain a stable three-ampere current throughout the plating time—a virtually impossible task since it would have to be done by manually raising or lowering the anode of each cell. A constant voltage was maintained by a fixed 50-volt DC power supply.

This report describes a redesigned apparatus that now automatically positions the cell anode to maintain the constant current of three amperes. Twenty-four units have been fabricated and operated satisfactorily for several years.

THE AUTOMATED APPARATUS

DESCRIPTION

Each cell, shown in Figure 1, is an independent unit within a bank of twenty-four modules (Figure 2). A functional diagram of a unit is presented in Figure 3. In the description of the components that follows, reference should be made to the functional diagram.

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Figure 1. AN ELECTRODEPOSITION UNIT.

The transformer primary receives power from a remote variac which is adjusted to give 50 volts of direct current at the power supply's output. The transformer secondary is rectified by a full-wave bridge rectifier. The supply output is connected to the cell anode through a 0 to 5-ampere ammeter.

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Figure 2. A TWENTY-FOUR-UNIT ELECTRODEPOSITION BIN AND PCWER SUPPLY.

Figure 3. FUNCTIONAL DIAGRAM OF THE ELECTRODEPOSITION APPARATUS.

The selected portion of voltage that is developed across the current-adjust potentiometer by the cell current is compared to a reference voltage through the gain potentiometer. Any difference in voltage is chopped and fed to the amplifier. The phase of the chopped voltage is detected by the contact of the chopper which is connected as a synchronous rectifier to the amplifier output. The amplifier output results in either a positive or negative voltage depending on the phase of the chopped signal. This voltage is directed to one of the two relays by the diode guides. When the relay is energized, it connects the motor to either a 12-volt positive or negative supply, depending on which relay is closed. The motor then either raises or lowers the anode in the cell solution until the difference in voltage, as seen by the amplifier, is zero.

OPERATION

Cell Calibration Procedure

Assemble a cell, as shown in Figure 4, and locate the cell on the plating unit, as shown in Figure 1. Turn the local-remote switch to the "off" position and turn on the bin power supply. Press the retract switch and hold until the anode holder stops at the upper limit of its travel. Connect the platinum electrode to the anode holder with the anode holder touching the mesh cylinder. Turn the local-remote switch to the "local" position and, when the anode reaches its lower limit of travel, turn the

Figure 4. REDESIGNED CELL ASSEMBLY.

switch to the "off" position. Now, adjust the platinum electrode until the bottom of the mesh cylinder is just above the cell bottom. Press the retract switch until the anode reaches its upper limit of travel. Pour 60 milliliters of electrolyte into the cell and turn the local-remote switch to the "local" position. Adjust the current adjust control to a desired ampere setting. Increase the sensitivity control until the anode "hunts" the predetermined setting, then decrease the sensitivity to just below the point that the anode was hunting. Turn the local-remote switch to the "off" position and retract the anode by pressing the retract switch. After each unit in the bin has been calibrated in this manner, turn all local-remote switches to the "remote" position.

Automatic Operation

For automatic operation, the timer is set at the remote control panel and the start switch is turned to the "on" position. Each platinum electrode should lower into the electrolyte and maintain the current selected in the local calibration. When the timer cycle is completed, power to the cell is discontinued and each platinum electrode will retract to its upper limit.

AVAILABLE DRAWINGS

Drawings for the apparatus described in this report will be made available through the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, US Department of Commerce, Springfield, Virginia 22151. These drawings are as follows:

<u>Drawing Number</u>	<u>Title</u>
D-I-28706	Amplifier Assembly Fabrication and Wiring Diagram
D-I-28804	Schematic Diagram
D-I-28838	Motor Drive Control Box and Details
E-I-36304	Instrument Panel Details and Wiring Diagram
E-I-36220	Instrument Cubicle Fabrication and Details, Sheet 1
E-I-36249	Instrument Cubicle Fabrication and Details, Sheet 2
E-I-36271	Instrument Cubicle Fabrication and Details, Sheet 3
E-I-36294	Instrument Cubicle Assembly and Details