Water management at Rössing uranium mine, Namibia

M. T. R. Smit
C. P. Brent
Rössing Uranium Ltd, Swakopmund, Namibia

ABSTRACT

Water management at a large uranium mine and leaching plant located in a desert environment is described in respect of reducing water consumption and controlling and containing contaminants. The extent to which water consumption has been reduced by innovative measures to reduce water losses and increase water recycle is described. Although the recycling of untreated solutions generated in the process has had negative effects on plant throughput and recovery, the overall benefit has been significant. Measures employed to ensure that no contamination of local groundwater occurs are described.

INTRODUCTION

Rössing Uranium is located approximately 65 km inland from the West coast of Namibia at latitude 22°25’ and longitude 15°01’. The operation consists of an open pit, an acid leach plant and a sulphuric acid plant.

The open pit mines ca. 2.5 million tonnes per month, supplying the plant with ca. 1 million tonnes per month of ore. The circuit consists of four stages of crushing, open circuit rodmills, sulphuric acid leaching, sand and slime separation and washing, continuous ion exchange, solvent extraction and Ammonium diuranate (ADU) precipitation and calcining.

The Acid Plant produces ca. 720 tpd of concentrated sulphuric acid from pyrite for consumption in the leach process. Tailings are disposed of by pumping the slurry to a disposal dam located nearly 1 km from the plant at a mean elevation of about 50 m above the plant and covers an area of some 650 ha.

The company employs ca. 2300 people, of whom ca. 1000 and their families reside in the town of Arandis, 15 km from the mine site, whilst the rest stay in the coastal town of Swakopmund, 65 km from the mine. The mine is located in a desert environment with a mean rainfall of 30 mm per year, a mean evaporation rate of 7.2 mm per day and temperatures ranging between 4°C and 40°C.

WATER MANAGEMENT

Due to the desert environment of the mine site and the nature of the process, it is necessary to pay considerable attention to management of the available water resources and prevention of groundwater contamination by seepage from the Tailings dam.

Potable water is supplied to the coastal towns of Walvis Bay and Swakopmund as well as Arandis.

More detailed descriptions of the process are published elsewhere.
and Omaruru rivers by the Department of Water Affairs. This department is the water controlling authority in Namibia and Rössing has regular and frequent contact with them. The position of the major pipelines and well-fields is shown in Fig. 1.

As a result of population and industry increases on the coast during the past decade (expected to accelerate subsequent to independence), the limited water resources are put under increasing pressure.

Rössing is the largest consumer on the coast (double the consumption of the town of Swakopmund with a population of ca. 18 000) and has a moral as well as commercial interest in ensuring reliability of water supplies and maintenance of water quality. These two objectives have been met by reducing potable water consumption by 50% during the last decade and by establishing efficient control and containment measures to prevent local contamination of groundwater resources.

REDUCTION OF WATER LOSSES

Figure 2 shows water consumption on the mine site since the start of operations in 1977. It can be seen that fresh water requirements increased to about 28 000m³/day as the mine worked up to full production in 1980. By this time a tailings pond containing some 10 million m³ of acidic solution had been built-up. Recycle of this RDS (return dam solution) to the metallurgical plant commenced in 1981. The major components of the Rössing water circuit are shown in Fig.3. It can be seen that not only is water recycled from the tailings dam but also from the seepage dam. This seepage dam is situated about 1 km downstream of the main tailings wall at an elevation some 70 m below that of the tails pond. Also shown on Fig.3 is the utilisation of brack groundwater from the nearby Khan River in the water circuit. The acidic RDS was fed directly to the roddils as a partial replacement for fresh water. Later RDS was brought into use as glandseal service on the large tailings slurry pumps. The increasing level of recycle which can be seen in Fig.3 reached a peak in 1985 when about 75% of mill feed water consisted of recycle solution. This allowed a considerable reduction in fresh water consumption but during 1986 and 1987 consumption had to be increased since the tailings pond had been depleted to a very low level. Since the beginning of 1988 new savings measures which are described below, have reduced mine site fresh water consumption to about 12 000m³/day with confidence that this level should not again be significantly exceeded during the rest of mine life unless production increases.

By setting up a mine site water balance (a simplified version of which is shown in Fig.3 where a balance for the period May to December 1987 is compared to a balance for November 1990), it was possible to identify the major water losses from the Rössing system. From Fig.4 it can be seen that the losses occurring on the Tailings dam are the major component and efforts were thus concentrated in this area. By means of far-reaching changes in tailings deposition method, losses from the dam have been reduced by some 10 000m³/day over the past three years. These changes fall into two main categories.

Improved Control of Tailings Pumping System

Problems encountered with the original design of the tailings systems, and subsequently resolved, are described elsewhere. Subsequently tailings pumping was controlled by maintaining the slurry velocities in the tailings lines at a level high enough to ensure that no choking of pipelines occurred due to coarse particles settling out. Velocities were typically in the order of 4.2m/s, and required the addition of significant volumes of transport solution to the tailings pulp. Once it was realised that a high proportion of the water losses occur because of the excess transport solution added, efforts were directed towards reducing tailings pumping velocities.