

RAINWATER STORAGE AND RETRIEVAL FROM BACKFILLED MINE PITS - AN INNOVATIVE APPROACH

A. G. Chachadi

Department of Earth Science, Goa University, Goa

ABSTRACT

Backfilling of the mining pits which are exhausted in the ore reserves is a normal practice to reclaim the land. In some areas the invaluable groundwater is trapped unused and in order to retrieve this trapped groundwater while allowing for rainwater storage within the reclaimed mine pit an innovative method has been designed and the details are given in this paper.

INTRODUCTION

In general, artificial recharge to ground water aims at augmentation of ground water reservoir by modifying the natural movement of surface water utilizing suitable civil construction techniques. The basic purpose of developing the present method of rainwater and groundwater storage and retrieval is an effort to restore supplies from aquifers depleted due to mining and backfilling activities. The basic requirements for such installations are: the availability of significant groundwater seepage at the mined out pit, sufficient rainfall to harvest and provisions for such schemes in the mine closure plan regulations.

LOCATION OF THE EXPERIMENTAL SITE

Velguem-Surla Iron Ore Mine of M/s. V.M. Salgaocar & Bros located in North Goa district consist of 4 contiguous mining leases in Velguem and Surla and Sonus-Vonvoiliem villages of Bicholim and Sattari Taluka respectively of Goa State (Fig. 1).

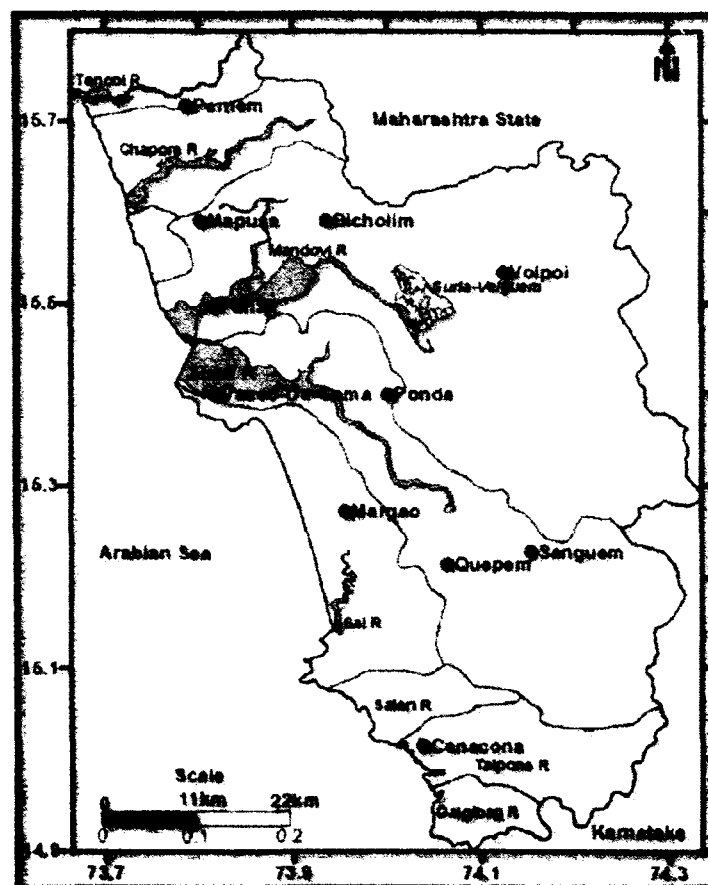


Fig.1: Location of the watershed in which the mine is situated

MINING

Mining operations at Velguem-Surla Iron ore mine commenced in early 1950's on manual scale, and subsequently mechanized in late 1960's. The mine is being worked systematically from NW to SE along the strike direction. Over the years, a part of the deposit in the north western end has been demineralized and since from the year 2005, the area has been taken for reclamation by backfilling and this practice of concurrent mining and reclamation by backfilling is in course.

RECLAMATION OF DEMINERALIZED MINE PIT BY BACKFILLING.

As a part of progressive mine closure plan, the demineralized block of 20.50Ha is being reclaimed by backfilling. So far an area of 16.4 Ha has been covered and in future the same would be extended further South. The highest level backfilled in stages is 87 MSL. The lower most stage on the inactive side has been stabilized by pitching and plantation. The higher levels along the common boundary with neighboring mine towards inactive stages are stabilized by Coco Erosion Control Blanket and Plantation. Different ex-situ conservation plots like "Matoli" (a plot dedicated for conservation of rare and economically useful plants used in traditional decorations during Ganesh Chaturthi festival in Goa) and "Fruit Park" are being developed on the reclaimed stages (Fig.2).



Concurrent Mining and Backfilling



Systematic stage-wise Backfilling of demineralised pit



Reclaimed part of the pit with CECB covered slopes



Present status of reclaimed part of the pit rehabilitated with plantation.

Fig.2:Reclamation of mined area in the Velguem-Surla mine of M/s. V.M.salgaocar & Bros.

Reclamation of the pit by back filling would affect the accumulation of water in the mining pit which was hitherto being pumped out for supplying to the nearby agriculture field. Hence, it was thought to develop a new concept of creating an artificial aquifer by construction of a well with permeable rock layers around it at different levels of back filling.

CONSTRUCTION OF ARTIFICIAL AQUIFER

Having planned to construct an artificial aquifer, a small portion of the ore body was retained towards the footwall (western) side within the demineralized block with an aim to have a ground water recharge point over the proposed backfilled area as well as to have a tapping source of water over the area subsequent to backfilling.

The construction of well began with 2.5 m length perforated concrete pipes of 1.0m dia. laid over each other and connected with suitable collars to maintain the verticality and stability during backfilling process at the predetermined location (towards footwall) over the ore body. The peripheral portion is raised by boulder bed which forms the permeable chamber for accumulation and transmission of the ground water as well as monsoon water flowing in to the pit. The well will facilitate pumping of ground water. Presently nine concrete pipes of 2.5 m length have been placed up to 40.30MSL. Temporarily, a metal cap has also been installed for safety. Height of the well will be progressively increased by installing additional pipes as the reclamation proceeds till it reaches the envisaged surface level of 87 MSL.

The Stages of construction of such artificial aquifer is depicted below.



Fig.3:Base point of well with rubble layer around it connecting to groundwater body



Fig.4:Raising of rubble around the well and linking the water body through permeable rock



Fig.5: Inner view of well showing perforations

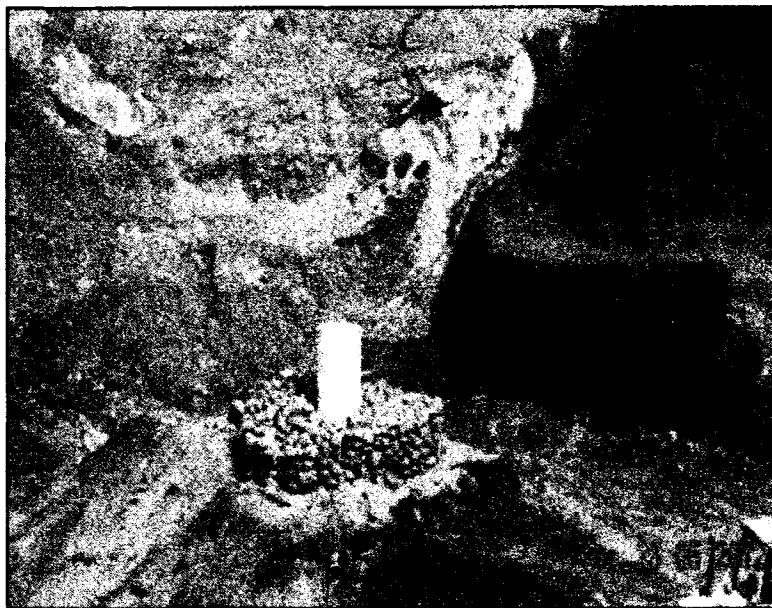


Fig. 6:A view of the well from a distance



Fig. 7:Well covered with metal cap for safety

Cross Section along Artesian Aquifer for Recharge Harvesting in Reclaimed Mine Pit

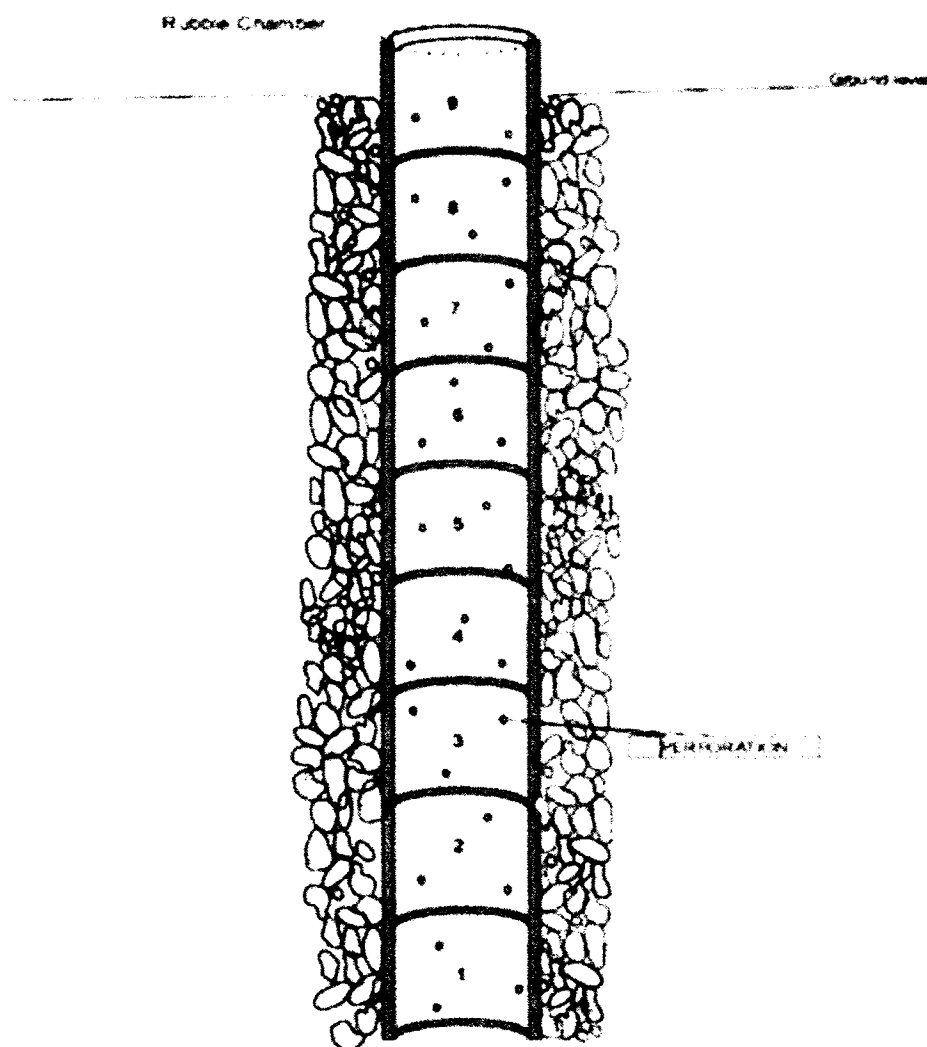


Fig.8: Cross sectional sketch of the well

PERFORMANCE EVALUATION OF THE WATER YIELD FROM THE WELL

Initial Pumping was carried out soon after the installation of the 9th pipe during May 2012. With a pumping rate of 15M³ per hour the steady state drawdown of 0.25m was achieved after 2 hrs of continuous pumping. The average pumping rate is computed as 360m³ per day which can meet demand of one village. On resumption of mining activity which has been banned presently further completion and pumping evaluation will be carried out to ascertain the quantity as well as the quality of water that would be discharged.

ACKNOWLEDGEMENT

The author is highly indebted to M/s. V. M. Salgaocar & Bros for accepting the experimental proposal and investing their funds in the project. The author also Thank Mr. Jayant senior geologist and all his colleagues for taking extraordinary interest in implementing this innovative work while they were very busy in their day today mining related tasks.