

EFFECTIVENESS OF THE CLIMBING BACKHOE  
IN COAL EXPLORATION

Paper presented

by:

K. Pomeroy

Denison Mines Ltd.

## EFFECTIVENESS OF THE CLIMBING BACKHOE IN COAL EXPLORATION

### INTRODUCTION

This paper reviews the experience of Denison Mines Limited in testing the effectiveness of the climbing backhoe in coal trenching and reclamation activities on the Saxon license area of the Northeast Coal Block in British Columbia. The experiment is followed from the planning phase (outlining the objectives of the trenching program, the environmental considerations, and the specifications of the climbing backhoe which made it attractive) through to evaluation of on-site performance.

### LOCATION

The Saxon property encompasses approximately 13,700 hectares of coal licences in the southern portion of the Peace River Coal Block in British Columbia. It is located some 170 kilometres south of Dawson Creek and stretches from the B.C.-Alberta boundary in a Northwestern direction along the eastern foothills of the Rocky Mountains. Elevations within the property boundary range from 1,100 to 2,000 metres.

The main environmental parameters of the site considered in formulating the trenching program were:

1. topographic relief - as a factor restricting road building and tracked vehicle access;
2. variable depth of overburden - which meant variable effectiveness of trenching techniques;
3. presence or absence of seepage - as it limited load-bearing capacity and vehicle access;
4. vegetation types - as they affected vehicle mobility, slashing requirements, and revegetation problems;
5. climatic factors - which dictated a short field season and placed high premium on efficiency.

## EQUIPMENT SPECIFICATIONS OF THE MENZI MUCK EH3000 CLIMBING BACKHOE

Two important, somewhat unique, specifications of the Menzie Muck made it a potentially valuable piece of equipment for use in the trenching program on Saxon. First, the Menzie Muck has two rear-mounted, wide-tired wheels, and two forward feet, all fully hydraulic. The two feet can be moved independently in both the vertical and horizontal planes; and the back wheels can be hydraulically raised or lowered, plus the wheels feature a gauge-widening of 2 metres allowing expansion of the wheel base from 1 3/4 to 3 3/4 metres. The result is that the backhoe can achieve increased stability in difficult slope locations, working effectively on 1:1 slopes. Consequently, it offered a potential solution to allow mechanical trenching on steep areas where constructing a road access would have meant significant erosion problems.

Secondly, the machine is light weight, with a total weight of approximately 4.5 tonnes, and it can be disassembled for air lifting by helicopter - a potential solution for machine-trenching alpine areas without the need to build roads which, in that vegetation zone, become serious reclamation problems. The machine's light weight means that it exerts very low ground pressures, only 0.68 psi with standard equipment, or half that value if equipped with special swamp pads. Thus it is suitable for use on ground with low load-bearing capacity, including seepage slopes and swamps. Because of these advantages, the Menzie Muck was considered a viable means of trenching while maximizing environmental protection.

Other specifications to note are:

- i) On the ground, the Menzie Muck pulls itself along by maneuvering both the hydraulic feet and the bucket, and it moves very slowly at a rate estimated to be under 1 mile per hour. For moving longer distances, it can easily be loaded on a truck bed, or pulled as a trailer.
- ii) Maximum lifting capacity is 1.8 tonnes; maximum reach, 6 metres; maximum digging depth, 4 metres; all of which are were adequate for the planned trenching operations.

## EXPLORATION PROGRAM OBJECTIVES

The primary objective of any field exploration program is to acquire sufficient information on stratigraphy, coal seam thickness and variability, and coal quality to allow an assessment, with an acceptable level of confidence, of the exact location, quantity and quality of available coal reserves and the resultant feasibility of mine development. Each of the four main types of exploration techniques used on Saxon, namely geological mapping, trenching, drilling, and adit construction, supply certain types of information critical in increasing the confidence with which reserve assessments can be made.

Trenching of surface coal seams, the exploration technique for which the climbing backhoe was tested, is relied upon primarily to provide information on the variability of coal seam thickness and on the presence of rock splits in the seam. Use of surface seam data is important in linking surface mapping to the detailed but widely scattered data points available from drill cores. Information derived from the trenching program is a function of both the number of trenches and their spacing on the seam, and the quality of trenches constructed. The choice of trenching technique therefore is a function not only of the constraints imposed by the environment, but also of the information required from trenching at a given stage in the exploration program.

Two main techniques have been used in trenching on Denison properties; hand trenching and mechanical trenching by bulldozer or cat-mounted backhoe. Experience with both techniques has shown that, in general, trenching operations conducted by mechanical equipment requiring road access to the site, resulted in comparatively large areas of surface disturbance at high cost. Hand trenching, where field crew support is provided by helicopter, dramatically reduces the amount of surface disturbance, associated reclamation requirements, and overall program cost. Thus, hand trenching has been favoured whenever it can satisfy the information requirements of the exploration program. For example, in 1976 some 60 hand trenches were constructed in alpine areas of Saxon South, yielding good information that greatly increased the knowledge of seam thickness and confidence in reserve calculations. Only 3 mechanically dug trenches were constructed.

Hand trenching however is much less effective in providing good quality trenches in some locations. It has been found that hand trenches must penetrate in excess of 1 metre of coal, to give consistent and reliable measurements of seam thickness and characteristics. Since in almost all locations below the treeline, and in some areas above the treeline, a relatively thick cover of soil and colluvium must be excavated; and, since the maximum practical hand-trenching depth is limited by the height of the trenches, few successful hand trenches are possible in forested areas. Boulders in overburden also limit effectiveness in some hand trenching operations.

#### CASE STUDY

In 1977, the exploration program on Saxon was at a stage where surface seam information was required from two locations which could not be practically hand trenched due to overburden depth. The areas were:

1. Saxon East: high elevation alpine ridges in a location covered with moderately thick colluvial deposits in an area without existing road access. Road access for mechanical trenching would prove expensive and cause major environmental problems.
2. Saxon East: a forested hillside of low elevation and with deep colluvium cover. Part of the area was in a seepage area downslope of a major swamp. The bearing capacity of these soils was too low to permit bulldozer crossing.

It was felt that the characteristics of the specialized Menzie Muck climbing backhoe outlined earlier would make it an effective tool at this stage in the exploration program, by achieving a trench depth impossible with hand trenching, negotiating difficult terrain, yet meeting the objective of relatively low surface disturbance and reclamation cost. In addition, the backhoe could be used for additional trenching planned for the alpine area of Saxon South, and it would also be useful in road ditching and culverting along the Saxon South exploration road.

Based on the previously discussed factors, the decision was made to lease the Menzie Muck EH 3000 for the summer program from an Edmonton firm at a cost of 3,000 dollars per month.

#### On-site Performance

##### 1. Trench Quality

The climbing backhoe proved equal to other backhoes in effectively excavating deep, clean trenches up to 4 metres in depth, achieving complete exposure of seam roof to floor and providing a good section for the geologist to log. An additional operational consideration (as with all deep trenches) was the need to provide a safety cage for the geologist to stand in while logging the trench. A specially constructed steel cage was lowered into the trench by the backhoe, and moved along as the geologist logged the trench.

##### 2. Efficiency in trenching

The machine was able to quickly excavate a trench, but suffered serious maintenance problems (largely with the hydraulic system) which dramatically lowered overall efficiency.

##### 3. Mobility

Transportation problems proved to be major factors and they limited the effectiveness of the machine in many applications. For example, the plan to airlift the backhoe to the proposed alpine trenching locations at Saxon East was abandoned when a Bell 205 helicopter could not lift the heaviest section of the disassembled Menzie Muck. Altitude and warm afternoon temperatures limited the lifting capacity of the 205. Success might have been possible with a lighter model backhoe, and this should be evaluated by potential users; but a helicopter with a greater lifting capacity was impractical due to excessive costs associated with the use of a helicopter larger than the 205.

On the ground, the backhoe was towed between widely spaced trenching locations with a skidder, a solution which introduced two major problems. Firstly, it meant that the backhoe could be used only in areas near existing road access (the alternative of new road construction to provide access was not considered); and secondly, the cost of trenching operations was escalated due to the cost of skidder rental and operation.

4. Effectiveness as a technique for minimizing surface disturbance and slashing requirements in trenching operations

In on-site use the Menzie Muck did result in less surface disturbance than a tracked vehicle—the wheels and feet made only minor indentations on most surfaces and it was judged almost as effective as hand trenching in reducing the impact in alpine areas. Slashing was also minimized as a result of the machine's maneuverability. The Menzie Muck can rotate through a complete circle, thereby minimizing turning area requirements; and in places where turning was required, it could be accomplished by a skilled operator in very small areas. Also, the slashing requirement was reduced by the ability of the backhoe to walk over many small trees by just bending them over.

5. Availability and Cost

The Menzie Muck is a highly specialized piece of equipment, and not widely available. Equipment rental cost (1977 figures) on the Saxon project were 3,000 dollars per month for the backhoe, and 30.00 dollars per hour for the skidder required to move it.

6. Operator Skill

The skill level of the operator is very important in extending or limiting the effectiveness of the machine. On Saxon, the lack of experience with the machine was considered to have limited both the working efficiency of the machine and its ability to negotiate difficult terrain.

#### SUMMARY

In conclusion, our experience with the climbing backhoe on Saxon underlined the need for a careful evaluation of site factors which could limit the effectiveness of the specialized equipment.

The backhoe did meet the objectives of 1) working well on swampy ground, 2) minimizing slashing requirements in forested areas, and 3) minimizing surface disturbance in alpine areas. However, the failure to airlift it to important alpine trenching locations, the requirements for a skidder to transport it on the ground, and the maintenance and operator problems combined to make the climbing backhoe program a poor investment when considered in relation to the useful information we wanted to acquire on this specific project.



DISCUSSION RELATED TO KATHY POMEROY'S PAPER

Question: What maximum steepness of slope can the backhoe operate on.

ANS. It depends on the type of overburden. We had quite a lot of trouble using it in any area where a tracked vehicle couldn't operate if there was a fair amount of loose colluvium over the rocks. The specifications say a 1:1 incline, but again that depends a lot on the skill of the operator that you have. I think that a lack of operator skill was part of the problem on the Saxon project. He was trained particularly for the project, but he had never operated one before and he had some trouble.

Garth Mayhew, University of Victoria. How much would this machine cost to buy.

ANS. The purchase cost we figured a year ago was 39,000 dollars, fully equipped.