RECLAMATION OF DUMP SLOPES

Paper presented
by:

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INTRODUCTION

In past meetings we have heard a number of good papers describing what is being done with dumps at various coal mines. I would like to discuss the reclamation of dump slopes, dwelling particularly on the underlying philosophy of reclamation. In addition, I will briefly review experiences at several mines.

RECLAMATION

Reclamation is the first word in the title of my paper. But what does it mean? Vast sums are spent in the name of reclamation. It employs the energies of many people; those in environmental groups, in government, industry and in universities. Yet its definition remains unclear.

It is obvious that there is no consensus on the meaning of reclamation. The organizers of this Symposium made this discovery in 1977. In response to a questionnaire, they received 105 definitions of reclamation. The definition varied, I suspect, depending upon the primary interest of the individual.

Let me review two of the more popular definitions derived from the questionnaire, namely:

1. Return the land to a useful state; and
2. Return the land to its natural state.

We must reject the latter definition in a literal sense. Taken literally, it means back-fill the excavations and reslope the dumps to the original contour. The costs of this would be staggering.

Taken in a more liberal context, these two definitions combine to become "return land to the useful state existing before disturbance".
Is this a reasonable definition of reclamation? When viewed from an economic standpoint the definition breaks down. The fact is that mining renders the land vastly more valuable than the original use. Let me use Lornex as an example. The original economic base of this mine site was a forest. The value of this renewable resource on a 100 year cycle is 1/4 million dollars over all the disturbed area. This amounts to one hundred and thirty dollars per disturbed acre. I would like to compare this with the new economic base, mining. In 6 years the mine has paid out in wages, taxes and purchases over 470 million dollars. I might add that Lornex is still in debt. These payments have rendered the land over 1000 times more valuable than the 100 year forest. Is it therefore realistic to further burden this enterprise with the cost of re-establishing a forest? Does it make economic sense to spend 300 dollars per acre to create a 130 dollar per acre forest?

While reclamation may be difficult to describe in an economic sense, it can be defined in the environmental context. Simply stated, mine sites should not be left in a state dangerous to the environment. In terms of dump faces, reclamation should render the slope environmentally stable.

Specifically, dump faces should not be subject to rapid erosion. Slow erosion on a geological scale cannot be avoided; however, rapid erosion silts lakes and streams through wind and water action. Reclamation must prevent silting.

Under this definition there is no intent to spend millions in rapidly changing the visual impact of a dump. Many people feel dumps offer no more visual offence than a talus slope. See Figures 1 and 2.

I suggest that it is misuse of our precious economic resources if the sole purpose of a reclamation project is to change the aspect of a dump face from multi-coloured rock to grass green.
FIGURE 1
WASTE DUMPS AT LORNEX

FIGURE 2
NATURAL TALUS SLOPE
STRUCTURE OF MINE DUMPS

Before dealing with the techniques of dump face reclamation, let us examine the form and construction of dumps.

Most open pit mines in B.C. are developed into the side of a hill in a series of benches 30 to 50 feet high. Every effort is made to haul the waste from these benches on level roads in order to avoid the up and down hauls which are generally more expensive than the level haul.

The result of level haul roads is a dump face height roughly equal to the bench height. The dumps so formed may be termed "contour dumps". However, as the mine matures the dumps become higher. When haul distances reach a certain length, attempts are made to find shorter routes. One technique is to dump out into the valley, thus creating a higher dump face. These higher dumps, while more economical to build, are more difficult to reclaim.

RECLAMATION OF DUMP SLOPES

Techniques for reclamation of dump slopes depend on the characteristics of the slope face material. If the material is coarse and resistant to weathering the dump is environmentally safe. Reclamation may be as simple as localized trenching and sloping to ensure that seasonal runoff does not attack sensitive areas. I would suspect that Craigmont, Bethlehem and many small underground metal mine dumps would fall within this classification.

Some dumps will need a mantle of vegetation to prevent rapid erosion. Material requiring this treatment would be overburden, and rapidly eroding sedimentary rock. Dumps in high rainfall areas such as Island Copper may also need a protective cover.

One important economic aspect of reclamation of these dumps is the face angle. What face angle will support an anti-erosion cover? A study of papers presented at previous Symposia indicates that 26° was the first recommended angle. Milligan and Berdusco of Kaiser reported in their 1977 and 1978 papers that some dumps could be left at 30°. They pointed to the
considerable cost savings of the steeper angles. Popowich also commented on dump face angles in his 1978 description of the Fording dumps. He questioned resloping to 26°, "when natural areas in the Fording Valley support vegetation growth on slopes in excess of 30°".

Popowich quotes costs of 1,000 to 5,000 dollars per acre for resloping. Mine developers studying new projects would therefore be wise to determine the degrees of resloping, if any, that is required for their future dumps. At these costs, dump resloping can have an important economic impact on a production decision.

Turning from the coal mines, other operations have shown success in planting at the angle of repose. Jim McCue will describe in his paper tomorrow, the very visible planting carried out at Similkameen. Lornex has several 37° planted test slopes. Bethlehem has made extensive use of steep slope planting with hydroseeding, and the Ministry of Highways has had success at the angle of repose when planting the flanks of fill sections.

Mother Nature gives perhaps the best example of all, illustrating that planting can be successful at the angle of repose. These examples of naturally vegetated talus slopes can be seen throughout the province (Figure 3).

CONCLUSIONS

To conclude this paper I would like to review the main points:
1. The cost of returning most B.C. mining land to the natural state is prohibitive.

2. The primary objective in dump face reclamation should be protection of the environment.

3. Visual impacts of dumps are in the eye of the beholder. Clean rock dumps are comparable to the natural talus slopes that decorate many B.C. valleys.
FIGURE 3

NATURALLY VEGETATED SLOPE
AT THE ANGLE OF REPOSE
4. If planting is necessary for environmental protection, the face planting angle depends on the material, climate and dump dimensions. The dump angle need not be as flat as 26° and can often be at the angle of repose.

If reclamation is viewed in this context, society will be able to maintain a common sense balance between a strong mineral based economy and meaningful environmental protection.
DISCUSSION RELATED TO DON GRAHAM'S PAPER

John Dick, B.C. Ministry of the Environment. You have dealt a lot with slope, and of course the most important relationship is between the degree of slope and the slope length. In fact, just about every one of the slopes that you have shown at the angle of repose was less than 100 feet long. Have you done anything to look at the relationship between degree of slope and slope length?

ANS. I know that this question has come up before and we are endeavouring to do some hand seeding on longer slopes at Lornex. I think they were actually seeded last fall so it will be a year before we really know how well they germinate. The only thing I can say, is in relation to some of these natural slopes. You have probably got quite a bit of experience in the coal mines in the south, but in the metal mines we just don't have that much experience, yet.

Dave Poster, Techman Ltd. Regarding your comment on the natural slopes. I studied talus slopes a while ago and found that when vegetation was obtained at the top when the dump material is fine and at the bottom where there is moisture so that it's probably a moisture related thing. In the middle where you have coarse material and where little moisture exists, is where you will have difficulty getting vegetation.

ANS. That would seem to make sense. Certainly there is a segregation due to the gravity, and generally you get the coarser material on the bottom. One of the points in my thesis is that if it's environmentally stable, that is, if the coarse rock isn't breaking down, you don't really have a threat to the environment from a silting aspect.

Neil Duncan, Energy Resources Conservation Boards. In the kinds of things you refer to, you may have some success in establishing vegetation on the benches between the slopes of the natural angle of repose. Have you done any work in that quarter in the hope that the vegetation would establish itself on the bench and then spread upwards and downwards from the benches.
ANS. Well, we have done test work for a number of years on plots on the flat of the dump, but unfortunately these dumps are active and we have had a heck of a time keeping the test plots from being covered over by the next year's operations. So we just haven't been able to get into that aspect. You have raised an interesting point, though, Neil. Of course, if we don't reslope these dumps, and if we could leave them at the angle of repose, then that leaves a substantial flat area. In other words, instead of going for a compromise of a long steep slope, you are left with a very steep slope plus the flat areas and we are hoping that the flat areas will be much more productive. It depends on what your objectives are of course, but if you are interested in producing a productive crop area or forest, I really think you have a much better chance on the flat areas of the dump.