IMPACT OF DAWSONITE AND NACOLITE ON PICEANCE CREEK BASIN OIL SHALE ECONOMICS

WALTER E. HEINRICHS, JR.

ABSTRACT

Recent identification of major quantities of dawsonite and nacolite oil shale in the Green River Formation of the Piceance Creek Basin, may have crucial effect on local oil shale development. The total resource potential has been vastly increased and thus the ultimate importance of early conservative exploitation becomes even more essential.

It is incumbent upon government and industry to cooperate on ways and means to immediately initiate long range programs and begin testing various development methods. It will take the combined know-how of both groups, under a climate of healthy private enterprise incentives and competition to gain maximum public benefit. If this is not done soon, the tremendous value to our economy will soon pass and the opportunity to apply it toward improving our own living standard and that of others will be lost forever.

INTRODUCTION

Another year and here we commiserate again on the status of the oil shale industry. What progress was made during the past year? How do we stand now? What does the future portend? What facts are available and what is rank speculation? Based on some stale experience but mostly on a rather recently crammed birdseye background, and at the risk of contradiction by the more constant experts, I want to outline the salient factors as I see them.

For over a year, my company has been retained by Mr. Joe Juhan to make certain preliminary studies regarding the association of low grade soda ash and aluminum ores with the oil shale in the Piceance Basin. Other facilities and personnel at the University of Arizona contributed substantially, in particular Dr. John Anthony, who made extensive mineralogical examination of continuous drill core of the pertinent section from Mr. Juhan's well located near the center of the basin.

Seemingly the oil shale record is almost drowned in technical literature, studies, and re-studies dating back to 1920 and older. Although progress

President and General Manager, Heinrichs Geoexploration Company, Tucson Arizona.

has been made each time, there are still important diverging opinions. Finally, now there may be more room for compromise and action.

Everyone agrees we are dealing with a resource potentially of major geo-political magnitude, but this potential will not last forever. If we are to benefit most constructively from this resource, we must move now, regardless of necessary compromise. History and common sense inevitably tie the health of society to raw material production. No better example exists than our own case since 1850, Canada since 1940, and Australia since 1960, as a more recent example.

Certainly it is unfortunate that our best decisions too often do not meet the test of mass popularity, and here, of course, is the root to much of our present ecological conflict. Policy of our Interior Department can have profound effect on these matters; however Interior is not part of Congress and should not operate on a Gallup Poll basis. Culmination of today's gravest mineral land problems are exemplified in our present oil shale situation. These are largely the result of mutual non-feasance, short sightedness, and past expediencies of both government and industry.

Surely by now this nation has the technical knowledge, leadership, and foresight to forge broad, firm, and equitable policies for the urgent needs of long-range development and orderly and increased production of our vital domestic mineral resources. Perhaps, the occurrence of other minerals besides oil will be the catalyst to help get adequate policy shaped and shale-oil development started.

RESPONSIBILITY OF GOVERNMENT AND INDUSTRY

To some, the ideal industry is totally invisible, odorless, soundless, with no waste product, and one hundred percent conserving. As yet, this is neither feasible nor practical. On the other hand, aside from simple self-preservation, we are morally committed to increasing living standards, fighting poverty, reducing our financial deficit, defending our nation, and continually taking care of the general welfare of more and more people. Obviously, this requires constantly increasing domestic production of everything. Really, we have very little choice except to do the job as wisely as possible and without needless waste and destruction.

Fortunately, ancillary factors for the establishment of a viable major new basic industry are favorable in the Piceance Basin. These include unusual compatibility with modern concepts of population and industrial dispersion, multiple use conflict, conservation, anti-pollution, and reclamation. Important agricultural potential, including timber, is minimum or nil, as would also be the effect on existing wildlife, and no exceptional scenic wonder is involved. The natural basin configuration, with proper added safeguards, such as small dams and other minor features, will control any potential groundwater or stream pollution. Much of the water used would be recycled. Any potential air pollution certainly can also be effectively controlled.

Some worry is expressed regarding so called windfall profits. Considering the magnitude of capital required, the extreme nature of the risks involved, and the length of time until payout, this is totally unrealistic. If private enterprise competition is encouraged, then profit will only be proportional to maximum conservation and production efficiency, with market control and the real benefits going to the ultimate consumer, the public. Naturally the effects on established industries and on foreign economy and imports must be considered, but so should all the other rapidly changing domestic and international factors. As a nation we can no longer act entirely unilaterally in any field.

Much has been said. considerable funds expended, and major new tests are planned for better ways and means to recover oil from the shale. The main considerations of mining and refining methods and costs have been studied and valuable work in this continues. However, by the addition of soda ash and aluminum into the picture, a new situation exists. If maximum recovery at least cost of all potential products is to be our objective, then clearly, open cut mining is most desirable, but some doubt if it is feasible. To explore this question, let us first look at the things involved besides oil.

NACOLITE AND DAWSONITE CONSIDERATIONS

The principal sodium minerals, near the basin center, begin to appear above 1800 feet below the surface and extend intermittently to below 2600 feet. The richest zone of these, though not continuous, is about 500 feet thick and lies between 1850 feet and 2375 feet below the surface. This zone is included within the much thicker oil shale zone above and below, and all become shallower and thinner toward the basin margin. For discussion and simplicity and correlation with previous reports, we can assume a maximum overburden thickness of approximately 1000 feet on top of 2000 feet of mixed pay zone, with proportionately less thickness for each as one approaches the basin edge.

Present value ratio, per vertical column unit, of recoverable material in the maximum known 2000-foot pay section is $9 oil, $7 soda ash and $2 alumina, or about $3.50 per vertical ton of ore on a weighted average basis. Recovered and refined equivalent products, expressed also as a ratio, is 1 ton of aluminum metal to 16 tons of soda ash to 30 tons of shale oil with each of these being worth roughly $500 at today's market. Thus the total potential value of the basin reserves is about tripled by adding the sodium byproducts.

DEVELOPMENT, MINING METHODS AND COSTS

In proposing open cut mining, I do not mean totally to ignore other methods. Block caving is still a possibility and, of course, nuclear blasting may be justified for open cut preparation aside from the various in situ recovery considerations. Several types of very large continuous mining machines and semi-portable belt conveyors should receive careful scrutiny. Dr. Tell Ertl covered the idea in his 1965 paper, although his figures now may be too conservative.

Mining a section of ore to 3,000 feet deep will need a trench or inverted pyramid no greater than 6,000 feet wide at the surface in the basin center, and this width would decrease toward the basin edge if slopes greater than 45 degrees can be tolerated. If controlled, self-induced open caving methods can be perfected, the width may decrease even more, with a corresponding reduction in stripping and blasting costs. Once room is developed at the bottom of the pay section, then overburden and spent shale can be back-filled into the mined out areas and the surface permanently reclaimed for other future uses. The fundamental procedure is somewhat akin to placer dredge mining operations. Minimum unit rate of mining and stripping for optimum efficiency would probably not be much less than 100,000 tons per day each—from an area of about 5,000 acres per unit operation. Unitization of land holdings to fit this minimum order of magnitude scope will be most desirable, although selected portions of the basin may allow unit operations one-half or even one-quarter this size.

Initial strip ratio on first cut or pass would be in the vicinity of one to one but from then on would decrease approaching one half to one. Mining costs for ore and waste will be much less than $0.25 per ton and waste disposal and reclamation less than $0.10 per ton of material re-handled. Initial capital investment estimates may approach $250 million, 40 percent for stripping and 60 percent for plant for the average operation, but this may vary somewhat depending on differing factors over the whole basin, and especially the relative stripping ratios and costs required to start production at a given unit.

These elements can only be removed from untenable risk and speculation by completely and carefully drilling, sampling and testing based on the statistics of chemistry, distribution, spacing, and representation of tests and sampling. The next stage may be to confirm these results by sinking shafts and obtaining bulk samples for pilot plant beneficiation tests. This would allow also for a more accurate appraisal of production methods and costs, water disposal, availability, requirements, and related problems. Such programs often consume 5 years or more before any real production is achieved. Concurrently, in other areas, other approaches such as underground block-caving, room and pillar, or in situ nuclear blasting techniques should be under way if the need otherwise continues to be indicated.

CONCLUSIONS

Although other electrical power may be available at less cost, conceivably the shale oil (and some soda ash) might be utilized in aluminum reduction. Very cheap soda ash might find and develop new markets eventually, but much will depend on related transportation factors which also will affect the aluminum economics.

In any event, if most of the sorting out is done on a competitive private enterprise basis in a climate of reasonable and equal rules for all concerned, the result will be the earliest establishment of a most important and worthwhile new industry for the maximum benefit of all.

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