ALFALFA HARVESTING COSTS

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University of California, Davis

This publication shows the costs of various methods of harvesting field-cured hay. It covers conventional baling, large roll bales, loose hay stacking, field and stationary cubing. It is based on several field cubing and baling operations in the Sacramento and San Joaquin Valleys, and on three stationary cubing operations (six machines) all of which have operated several seasons. Figures for stacking wagons are based on cow-calf operations in California, plus large roll bale and stack data from the University of Oklahoma.

Cost Summary

Table 1 compares costs of harvesting alfalfa using the different harvesting methods. The costs in the table are based upon 5,000 tons annual production, an amount considered reasonable for most of the harvesting equipment. A stationary cuber can handle about 10,000 tons per year. These summary data show that cubing is the most expensive method. However, cubes have several advantages. These include mechanized handling and feeding, and reduced labor, storage space, and feeding waste. The overall cost of producing cubes in the field is less than for stationary operation when compared at the same annual tonnage. The difference is small when annual production exceeds the capacity of a single field machine. The large, round bales and stack wagons are the least expensive methods of harvest but these can be successfully transported for only a relatively short distance. Therefore their use is limited largely to ranches where the hay will be fed.

Hay harvesting involves large investments for equipment and facilities. Table 2 shows the approximate cost of equipment required for each system. These investment costs are reflected in the overhead cost of production in subsequent calculations.

Machine Performance and Cost Analysis

Field Cubing vs. Stationary Cubing--Several variables affect the productivity of the field cubing machine. Weather and its effect on hay moisture is one of the more important elements and cannot be controlled. Other factors such as irrigation timing and soil moisture, as well as general field conditions like ground roughness and crop uniformity, can be given limited control.

A stationary operation places the cuber out of the direct influence of field and weather and can operate for as long as hay is available. The stationary cuber can, therefore, be fed more uniformly at a rate near the machine's maximum output. Hay fed to the machine is also at a more uniform moisture level. These factors usually increased the hourly capacity of stationary cubers by at least 50 percent compared to field machines. While the capacities of both types of machines vary with conditions and management, it is not unreasonable to expect an average of 4 tons per hour with a field machine and 6 to 8 tons per hour with a stationary machine.

The number of hours of operation for a field cuber is limited to the period during the day when the hay is free of dew. In most areas this restricts operation to 8 to 12 hours each day. By contrast, stationary cubers can operate around the clock if a supply of hay is available. The stationary cuber output in this cost comparison was based on 16 hours a day (two 8-hour shifts) at an average output of 7 tons per hour. The number of days of operation per year may also be increased by either stockpiling chopped hay or using coarsely ground baled hay. Because of the extra costs, these two approaches have so far had only limited use. A normal seasonal operating period of 100 days was used for both the stationary and field machines.

The stationary cuber can be used to process artificially dried hay in areas where natural drying is unsatisfactory. A standby drier can be used for periods during the season to permit continuous operation of the cuber. Artificial drying, however, adds to the total cost of processing.
Although cubers are designed primarily for legume forages, they can be used for other materials, particularly agricultural crop residues like straw and cotton waste, and hay-grain mixtures. The stationary machine is best suited for these materials because adhesives must frequently be added and mixed before cubing.

While baling wire and tramp iron in hay cubes are not frequent problems, it is easier to provide magnets and metal removal equipment in a stationary cuber than in a field machine.

The stationary cuber is best suited for these materials because adhesives must frequently be added and mixed before cubing. While baling wire and tramp iron in hay cubes are not frequent problems, it is easier to provide magnets and metal removal equipment in a stationary cuber than in a field machine. The hay supply used in cubing operations is frequently drawn from a fairly large area. With field cubers, the entire operation including storage can be shifted to reduce the transport of hay. This is not possible with a stationary installation. Semiportable cubing units are available for in-field operation or for multiple site operation.

The multiple cuber aspect of a field cubing operation reduces the risk of a complete shutdown due to maintenance or repair problems. Mechanical failure on one field cuber would stop only a portion of the total. By contrast, mechanical failure in the single cuber of a stationary operation would completely stop cube production. However, stockpiling of chopped hay can continue despite stationary cuber breakdown, with around the clock operation when repairs are completed. Several stationary installations have two cubers, which also permits continued operation in the event of mechanical failure.

Stacks and Large Roll Bales--Large roll bales and stacks made with stacking wagons have gained widespread usage in much of the United States. They have had very limited use in California to date. It appears that they are suitable for use in cow-calf or dairy operations that produce and feed their own hay. They may also be suitable as a means of supplying hay to stationary and portable-stationary cubing or pelleting operations where the hay is grown within a short distance of the plant. In their present form, they do not appear to provide sufficient density and payload capabilities for long distance transport.

Cost figures show that the large roll bale and stack systems can reduce the cost of packaging and handling hay as long as the transport distance is relatively short. University of California Agricultural Sciences Leaflet 75-5P-30II "Big Hay Bale," provides additional information.

Storage Requirements--The need for covered storage for cubes varies with local rainfall. Light rainfall damages the pile's surface somewhat, producing some quality loss and waste due to spoilage. Covered storage is recommended, but producers in areas of very limited rainfall may decide that the investment is not justified. For both the stationary and field cubing operations, the costs include a cube storage building to provide storage for 50 percent of the annual tonnage. Costs are based on a flat storage building providing 5 square feet of floor space per ton at $5.40 per square foot. A solid floor, usually concrete, is needed to minimize handling loss and to prevent mixing with dirt or gravel.

Stationary cubing also includes 30,000 square feet of asphalt slab for stockpiling chopped hay before cubing. This item is included under stationary cubing costs.

Large roll bales and stacks made with stacking wagons are generally not stored under cover. It is recommended that large roll bales and stacks not be placed in contact with each other in outside storage as moisture will move into the bales at the point of contact. This precludes stacking large roll bales unless stored under cover.

Machine Costs--Machine life, output per hour and per season, and machine maintenance are major factors affecting the cost of hay harvest. Machine life is determined by wear-out or obsolescence, or both. In the case of a newly developed machine like the cuber, it is hard to estimate what these factors will be. Eight years seems to be a reasonable life. Life expectancy for the stationary cuber is estimated at 10 years because of less severe operating conditions. Life expectancy for other equipment is estimated from various references including the ASAE Yearbook.

"Other" charges shown in overhead costs are taxes, insurance, and storage of equipment computed at 2 percent of first cost of the machine of facility.

Repair costs are calculated for each operation. Data from field cubers indicate that expected annual repair costs are about 125 percent of the first cost for 10,000 hours or
wear-out life. Die wear is a major part of this total. Excessive maintenance during the operating season will be reflected in reduced annual production and higher overhead cost per ton. Many producers completely overhaul their cubing machines during the winter to reduce in-season maintenance. The figures are for normal operating conditions. Sandy soil or other factors creating unusual wear can increase repair costs.

Repair costs for stationary cubing were based on actual costs of existing installations with adjustments for inflation. Fuel consumption and repair information, unless otherwise noted, were taken from the ASAE Yearbook. Miscellaneous cash costs include office and telephone, interest on operating capital, and various small items.

A management and supervision charge of $1.10 per ton for cubes and $.55 for bales is included.

Cost Tables--The following pages are devoted to costs for harvesting alfalfa hay using the various methods which are available.

<table>
<thead>
<tr>
<th>TABLE 1. Comparison of Hay Harvesting Costs-- 5,000 Ton Per Year</th>
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<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Swath</td>
</tr>
<tr>
<td>Combine windrows</td>
</tr>
<tr>
<td>Bale</td>
</tr>
<tr>
<td>Chop and haul</td>
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<td>Cube</td>
</tr>
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<td>Stack</td>
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<tr>
<td>Swather 14 ft S.P.</td>
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<tr>
<td>Side rake (2)</td>
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<tr>
<td>Field cuber</td>
</tr>
<tr>
<td>Stationary cuber</td>
</tr>
<tr>
<td>Water nurse truck</td>
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<tr>
<td>Dump truck</td>
</tr>
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<td>Stacker</td>
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<tr>
<td>Baler - 3 wire pull</td>
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<tr>
<td>Baler - large round bale</td>
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<tr>
<td>Auto bale loader &amp; stacker</td>
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<tr>
<td>Forklift</td>
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<tr>
<td>Dry hay chopper</td>
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<td>Stack mover</td>
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<tr>
<td>Chopped-hay wagon (3)</td>
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<td>Cube storage</td>
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<td>Trucks</td>
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<tr>
<td><strong>Total</strong></td>
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<tr>
<td>Investment - up to 5,000 tons per year</td>
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<td>--------------------------------------</td>
</tr>
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</tr>
<tr>
<td>Side rakes</td>
</tr>
<tr>
<td>Baler, 3-wire pull type</td>
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<tr>
<td>Auto bale loader &amp; stackers</td>
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<tr>
<td>Tractors</td>
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Operating cost

<table>
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<tr>
<th>Tons per hour</th>
<th>Swath</th>
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<th>Bale</th>
<th>Roadside bales</th>
<th>Total per ton</th>
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Total Cost Per Ton at Various Annual Usage

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<th>Tons</th>
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<th>Operating cost per ton</th>
<th>Management</th>
<th>Total cost per ton</th>
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*Approximate upper limit for one baler, swather, side rake, tractor
TABLE 4. Cost of Harvesting Alfalfa With a Large Round Bale Baler

Investment - up to 5,000 tons per year

<table>
<thead>
<tr>
<th>Number of machines</th>
<th>Price</th>
<th>Life (years)</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Other</th>
<th>Total</th>
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<tbody>
<tr>
<td>Swather</td>
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<td>$ 4,200</td>
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<td>Side rakes</td>
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Operating cost

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<th>Tons per hour</th>
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<tr>
<td></td>
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<td>Labor</td>
<td>Fuel and repairs</td>
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<td>Swath</td>
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<td>$4.95</td>
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<td>Combine windrows</td>
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<td>Bale</td>
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<tr>
<td>Roadside bales</td>
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Total Cost Per Ton At Various Annual Usage

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<th>Tons</th>
<th>Overhead cost per ton</th>
<th>Operating cost per ton</th>
<th>Management</th>
<th>Total cost per ton</th>
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*Approximate upper limit for one baler, swather, side rake, tractor
TABLE 5. Cost of Harvesting Alfalfa With a Wagon Stacker

<table>
<thead>
<tr>
<th>Investment - up to 5,000 tons per year</th>
<th>Number of machines</th>
<th>Price</th>
<th>Life (years)</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Other</th>
<th>Total</th>
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</thead>
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<tr>
<td>Swather</td>
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<td>5</td>
<td>$4,200</td>
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<td>$420</td>
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<td>600</td>
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<td>Stack mover</td>
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<td>220</td>
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Operating costs

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<th>Tons per hour</th>
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<th>Move</th>
<th>Total</th>
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<tr>
<td>Labor</td>
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<tr>
<td>Fuel and repairs</td>
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<td>6.75</td>
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Total Cost Per Ton At Various Annual Usage

<table>
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<tr>
<th>Tons</th>
<th>Overhead</th>
<th>Operating</th>
<th>Management</th>
<th>Total cost</th>
</tr>
</thead>
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<tr>
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*Approximate upper limit for one swather, stacker, tractor
### TABLE 6. Cost of Harvesting Alfalfa With a Field Cuber

**Investment – up to 5,000 tons per year**

<table>
<thead>
<tr>
<th>Number of machines</th>
<th>Price</th>
<th>Life (years)</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swather</td>
<td>1</td>
<td>$21,000</td>
<td>5</td>
<td>$4,200</td>
<td>$840</td>
<td>$420</td>
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<td>7,315</td>
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<td>360</td>
<td>160</td>
<td>80</td>
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<td>Dump truck to haul</td>
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<td>200</td>
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</table>

**Operating cost**

<table>
<thead>
<tr>
<th>Tons per hour</th>
<th>Swath</th>
<th>Cube</th>
<th>Haul</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$4.50</td>
<td>4.50</td>
<td>4.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$4.95</td>
<td>11.20</td>
<td>1.25</td>
<td></td>
</tr>
</tbody>
</table>

**Total Cost Per Ton At Various Annual Usage**

<table>
<thead>
<tr>
<th>Tons</th>
<th>Overhead cost per ton</th>
<th>Operating cost per ton</th>
<th>Management</th>
<th>Total cost per ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>$26.65</td>
<td>$7.90</td>
<td>$1.10</td>
<td>$35.65</td>
</tr>
<tr>
<td>2,000</td>
<td>13.30</td>
<td>7.90</td>
<td>1.10</td>
<td>22.30</td>
</tr>
<tr>
<td>3,000</td>
<td>8.90</td>
<td>7.90</td>
<td>1.10</td>
<td>17.90</td>
</tr>
<tr>
<td>4,000</td>
<td>6.70</td>
<td>7.90</td>
<td>1.10</td>
<td>15.70</td>
</tr>
<tr>
<td>5,000*</td>
<td>5.35</td>
<td>7.90</td>
<td>1.10</td>
<td>14.35</td>
</tr>
<tr>
<td>6,000</td>
<td>6.95</td>
<td>7.90</td>
<td>1.10</td>
<td>15.95</td>
</tr>
<tr>
<td>7,000</td>
<td>5.95</td>
<td>7.90</td>
<td>1.10</td>
<td>14.95</td>
</tr>
<tr>
<td>8,000</td>
<td>5.20</td>
<td>7.90</td>
<td>1.10</td>
<td>14.20</td>
</tr>
<tr>
<td>9,000</td>
<td>4.65</td>
<td>7.90</td>
<td>1.10</td>
<td>13.65</td>
</tr>
<tr>
<td>10,000</td>
<td>4.15</td>
<td>7.90</td>
<td>1.10</td>
<td>13.15</td>
</tr>
</tbody>
</table>

*Approximate upper limit for one swather, cuber, truck
TABLE 7. Cost of Harvesting Alfalfa With a Stationary Cuber

<table>
<thead>
<tr>
<th>Investment - up to 5,000 tons per year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of machines</strong></td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Swather</td>
</tr>
<tr>
<td>Side rakes</td>
</tr>
<tr>
<td>Dry hay chopper</td>
</tr>
<tr>
<td>Tractor</td>
</tr>
<tr>
<td>Chopped hay wagon</td>
</tr>
<tr>
<td>Truck to pull wagons</td>
</tr>
<tr>
<td>Stationary cuber with</td>
</tr>
<tr>
<td>auxiliary facilities</td>
</tr>
<tr>
<td>Storage for cubes</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating costs</th>
<th>Tons per hour</th>
<th>Per hour</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Labor</td>
<td>Fuel and repairs</td>
</tr>
<tr>
<td>Swath</td>
<td>7</td>
<td>$4.50</td>
<td>$4.95</td>
</tr>
<tr>
<td>Chop and haul to cuber</td>
<td>10</td>
<td>4.50</td>
<td>15.00</td>
</tr>
<tr>
<td>Cube</td>
<td>4</td>
<td>4.50</td>
<td>3.20</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
<td></td>
<td>1.50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$6.75</td>
</tr>
</tbody>
</table>

Total Cost Per Ton At Various Annual Usage

<table>
<thead>
<tr>
<th>Tons</th>
<th>Overhead cost per ton</th>
<th>Operating cost per ton</th>
<th>Management cost per ton</th>
<th>Total cost per ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>$34.05</td>
<td>$6.75</td>
<td>$1.10</td>
<td>$61.90</td>
</tr>
<tr>
<td>2,000</td>
<td>27.00</td>
<td>6.75</td>
<td>1.10</td>
<td>34.85</td>
</tr>
<tr>
<td>3,000</td>
<td>18.00</td>
<td>6.75</td>
<td>1.10</td>
<td>25.85</td>
</tr>
<tr>
<td>4,000</td>
<td>13.50</td>
<td>6.75</td>
<td>1.10</td>
<td>21.35</td>
</tr>
<tr>
<td>5,000*</td>
<td>10.80</td>
<td>6.75</td>
<td>1.10</td>
<td>18.65</td>
</tr>
<tr>
<td>6,000</td>
<td>9.00</td>
<td>6.75</td>
<td>1.10</td>
<td>16.85</td>
</tr>
<tr>
<td>7,000</td>
<td>8.65</td>
<td>6.75</td>
<td>1.10</td>
<td>16.50</td>
</tr>
<tr>
<td>8,000</td>
<td>7.55</td>
<td>6.75</td>
<td>1.10</td>
<td>15.40</td>
</tr>
<tr>
<td>9,000</td>
<td>6.70</td>
<td>6.75</td>
<td>1.10</td>
<td>14.55</td>
</tr>
<tr>
<td>10,000</td>
<td>6.05</td>
<td>6.75</td>
<td>1.10</td>
<td>13.90</td>
</tr>
</tbody>
</table>

*Approximate upper limit for one swather, rake tractor combination

1/ See table 8
TABLE 8. Stationary Cubing (7 tons per hour - 1 cuber)

<table>
<thead>
<tr>
<th>Investment and Annual Overhead Costs:</th>
<th>Number of</th>
<th>Price</th>
<th>Life (years)</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paving for curing and storage, 30,000 sq ft of 6&quot; concrete at $1.75</td>
<td>1</td>
<td>$52,500</td>
<td>20</td>
<td>$2,625</td>
<td>$2,100</td>
<td>$1,050</td>
<td>$5,775</td>
</tr>
<tr>
<td>Stationary cuber</td>
<td>1</td>
<td>22,000</td>
<td>10</td>
<td>2,200</td>
<td>880</td>
<td>440</td>
<td>3,520</td>
</tr>
<tr>
<td>Electric motor, 150 hp</td>
<td>1</td>
<td>4,300</td>
<td>20</td>
<td>215</td>
<td>172</td>
<td>86</td>
<td>473</td>
</tr>
<tr>
<td>Power controls (weather protected)</td>
<td>1</td>
<td>7,600</td>
<td>20</td>
<td>380</td>
<td>304</td>
<td>152</td>
<td>836</td>
</tr>
<tr>
<td>Scoop loader (4 ton)</td>
<td>1</td>
<td>12,000</td>
<td>10</td>
<td>1,200</td>
<td>480</td>
<td>240</td>
<td>1,920</td>
</tr>
<tr>
<td>Metering box, mixer, feed conveyor</td>
<td>1</td>
<td>24,000</td>
<td>10</td>
<td>2,400</td>
<td>960</td>
<td>480</td>
<td>3,840</td>
</tr>
<tr>
<td>Conveyor to truck</td>
<td>1</td>
<td>4,300</td>
<td>10</td>
<td>430</td>
<td>172</td>
<td>86</td>
<td>688</td>
</tr>
<tr>
<td>Magnets</td>
<td>1</td>
<td>1,150</td>
<td>20</td>
<td>58</td>
<td>46</td>
<td>23</td>
<td>127</td>
</tr>
<tr>
<td>Dump truck (2 ton)</td>
<td>1</td>
<td>10,000</td>
<td>10</td>
<td>1,000</td>
<td>400</td>
<td>200</td>
<td>1,600</td>
</tr>
<tr>
<td>Scales (30 ton)</td>
<td>1</td>
<td>7,150</td>
<td>20</td>
<td>358</td>
<td>286</td>
<td>143</td>
<td>787</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$145,000</td>
<td></td>
<td>$10,866</td>
<td>$5,800</td>
<td>$2,900</td>
<td>$19,566</td>
</tr>
</tbody>
</table>

-76-
TABLE 9. Cost to Store Cubes

<table>
<thead>
<tr>
<th>Number of machines</th>
<th>Price</th>
<th>Life (years)</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage shed</td>
<td>1</td>
<td>$67,500</td>
<td>30</td>
<td>$2,250</td>
<td>$2,700</td>
<td>$1,350</td>
</tr>
<tr>
<td>Scoop loader</td>
<td>1</td>
<td>12,000</td>
<td>10</td>
<td>1,200</td>
<td>480</td>
<td>240</td>
</tr>
<tr>
<td>Elevator, loading</td>
<td>1</td>
<td>5,000</td>
<td>10</td>
<td>500</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>and stacking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scales, 30 ton</td>
<td>1</td>
<td>7,500</td>
<td>20</td>
<td>375</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$92,000</td>
<td></td>
<td>$4,325</td>
<td>$3,680</td>
<td>$1,840</td>
</tr>
</tbody>
</table>

Cash Operating Costs: Per ton

| Labor              | $ .45       |
| Fuel               | $ .30       |
| Miscellaneous, electrical power, repairs to shed & equipment | $ .75       |
| Total              | $1.50       |