XIX

ECONOMIC ANALYSIS OF THE HYDROSTATIC EXTRUSION OF SOLID ROUNDS AND TUBING

The objective of this section is to evaluate the economics of the hydrostatic extrusion process and to relate the findings to conventional processes. During the course of the overall program a large number of process variables and materials were evaluated. To make use of this large amount of information, the economic analysis was directed toward establishing meaningful trends and relationships between hydrostatic extrusion and conventional processes rather than directing the analysis toward one product and one material. The cost figures used in this analysis were based on actual equipment costs whenever possible. No basic modifications of existing tooling were assumed in this study, although it was assumed that additional fluid and billet-handling equipment would be used. Thus, this analysis reflects the current state of the hydrostatic extrusion process and the costs obtained herein may be lowered still further as production refinements take place.

The procedure used in this analysis was to establish a press cost on a hourly basis and then to apply appropriate factors, such as production rates, die life, and billet weights, to determine a conversion cost per pound of extrusion. In the case of tubing a conversion cost was determined as a function of extruded length. The analysis was limited to determining conversion costs rather than selling cost and, therefore, items such as return on investment, inspection costs, and selling costs were not considered. These items would require additional assumptions and would tend to make the final cost figures less meaningful.

The press costs for hydrostatic extrusion were estimated as shown from the figures on Table XXXVI. The press and related equipment was assumed to have a 10-year life. Factors of 25 percent and 15 percent of equipment cost used to determine building, engineering, and contingencies costs may vary for different operations but are useful to establish the magnitude of these costs. Assuming the maintenance cost equal to the equipment cost over the life of the equipment is an accepted accounting procedure. In the normal life of industrial equipment, little or no maintenance may be required in the first few years of service, but in the remaining years maintenance costs mount and experience has shown this assumption to be reasonable.

The container used in this analysis was assumed to have a bore 2-3/8-inch diameter x 40 inches long. Since the most expensive component in hydrostatic extrusion tooling is the container, the hydrostatic extrusion tooling cost was estimated by doubling the cost of a 20-inch-long hydrostatic extrusion container constructed recently during this program. The container would have a 5-year service life based on a fatigue life of 10^5 cycles.

The assumed labor cost would allow for either a two-man operation, each with a high degree of skill, or a three-man operation with one skilled operator and two helpers. Overhead factors vary with accounting systems and type of industry. The value of 100 percent is frequently used in many heavy industries such as extrusion or forging plants.

Service costs were determined from the press used in this current study. A final press cost per hour was determined to be $46.96/hr. This value was determined from the following relationship.

TABLE XXXVI. THE ECONOMIC BASIS FOR DETERMINING PRESS COSTS

A.	Capital Investment	
	1. Cost of a 700-ton press	$150,000
	2. Material-handling equipment (such as fluid pumps, and mechanical devices to clear and clean dies).	12,000
	Total Cost of Equipment	$162,000
	3. Building costs (assumed 25 percent of equipment costs)	40,500
	4. Engineering costs (assumed 25 percent of equipment costs)	40,500
	5. Contingencies (assumed 15 percent of equipment costs)	24,300
	Total Capital Investment	$267,300
B.	Operating Costs	
	1. Maintenance (equal to equipment cost over the life of the equipment)	162,000
	2. Hydrostatic extrusion tooling cost	30,000
	3. Labor ($10/hr x 100 percent overhead)	$20.00/hr
	4. Services (electric, water, etc.)	$2.50/hr

$$\frac{\text{Capital Investment + Maintenance}}{\text{10 yr x 2000 hr/yr}} + \frac{\text{Hydrostatic Tooling}}{\text{5 yr x 2000 hr/yr}}$$

$$+ \text{Labor + Service Costs = Press Cost per hour}$$

or

$$\frac{\$267,300 + \$162,000}{10 \times 2000} + \frac{\$30,000}{5 \times 2000} + \$20.00 + \$2.50 = \$46.96/\text{hr} \ .$$

The press operating cost per extrusion is, of course, directly related to the number of billets that could be extruded per hour. Using the tools developed in this program and assuming a relatively simple materials handling system, it was felt that the extrusion output could be up to 20 billets per hour for simple solid rounds extrusions or as low as 10 billets per hour for more complex extrusions. These production rates resulted in a press cost which varied from $4.696 to $2.348 per extrusion for production rates of 10 and 20 billets per hour, respectively. Additional costs would have to be added to these figures to cover the cost of dies, mandrels, fluids, and seals. These are considered on an individual basis in the following sections.