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THE ECONOMICS OF SHUTTING AND RESTARTING PRIMARY ALUMINIUM SMELTING CAPACITY

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Abstract

In recent years the aluminium industry in the Western world has been operating well below capacity, with cutbacks in production due largely to the depressed aluminium market conditions of 1992 and 1993. Since mid-1995, however, aluminium producers have begun restarting idled capacity. Extensive efforts and preparation are required both to close capacity in an orderly manner and to restart idled capacity. This paper presents a comprehensive analysis of the costs of shutting capacity, maintaining idled capacity, and restarting potlines.

Costs have been calculated for a smelter which may be considered representative of the industry as a whole. Technical aspects and commercial data are outlined for the representative smelter, with costs presented under a variety of shutdown and restart conditions. Additionally, the time required to bring capacity back on-line is examined for several scenarios, and the economic impact of idled capacity is discussed.

Introduction

In recent years, the aluminium industry in the Western world has been operating well below capacity. CRU International estimates that the average utilisation rate in 1994 was 87%. Viewed another way, some 2.1m tpy of capacity was idle on average during 1994. A significant amount of capacity has therefore been taken off-line since 1990-1991, when the industry operated at more than 98% of capacity.

The cutbacks in production were brought about largely by the depressed aluminium market conditions of 1992 and 1993. Cutbacks took place from mid 1991 through to early 1994, and were reflected in a steadily declining industry utilisation rate. Perhaps the most notable cutbacks were the 800,000 tpy of capacity committed in early 1994 by leading producers for a period of 18-24 months, in response to the inter-governmental "Memorandum of Understanding".

Since mid 1994, however, the industry utilisation rate has stopped falling, and the programmed cuts of 18-24 months made in early 1994 are reaching expiry. It is thus a particularly appropriate time to examine the costs of capacity closures. Shutting capacity is not a decision to be taken lightly. It is not as simple as turning off power to stop production and later turning it back on to resume production. Extensive efforts and preparation are required to restart idled capacity, as well as to close capacity in an orderly manner. It has often been said that it costs a smelter "millions of dollars" to shut down and then restart a potline. This paper presents an analysis of the costs of shutting down and restarting capacity, taking into account several scenarios. We also examine how quickly idled capacity can be brought back on line.

It is difficult to make a single cost estimate that is appropriate for all smelters, since each has a unique set of conditions for restart, including technology, supply contracts, employment levels, and labour agreements. In this study costs have been calculated for a smelter which may be considered representative of the industry as a whole, based on our weighted average full operating cost for 1994 (see Figure 1). The relevant technical and commercial data describing this hypothetical smelter are outlined, followed by general technical and cost aspects of shutting down and restarting potlines. Then the costs associated with shutting down and restarting this generic smelter are presented, along with several scenarios for the amount of time required to bring capacity back on-line.

Details of a Representative Industry Smelter

Technical and commercial assumptions for the hypothetical smelter are presented in Table 1. Typical operating costs are based on 1994 Western world weighted averages, as determined by CRU[1], for each cost component. Cost components as a

Figure 1: The Western World Full Operating Cost Schedule in 1994

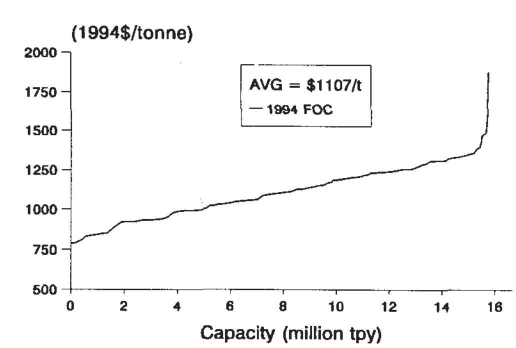

Table 1: Cost and Size Assumptions for a Representative Industry Smelter in 1994

Plant Component	Size
Number of Potlines	4
Number of Pots/Line	150
Total Number of Pots	600
Amperage	120 kA
Capacity	200,000 tpy
Average Pot Life	2000 days
Number of Employees	1000
Cost Component	**Cost**
Power	18.3 mils/kWhr
Alumina (@ 1.936 t/t Al)	$172/tonne
Labour (wages plus benefits)	$24,600/year/employee
Bath Materials (total component costs @ 0.034 t/t Al)	$692/tonne
Anode (total materials and labour @ 0.569 t/t Al))	$156/tonne
Maintenance & Materials	$60/tonne Al
Pot Relining (materials and labour)	$68,860/pot
Casthouse (conversion costs)	$30/tonne Al
Overheads (incl. headqtrs, contractors, R&D)	$69/tonne Al
Freight plus Interest on Work in Progress	$56/tonne Al

proportion of full operating costs are shown in Figure 2. We have chosen 1994 as the base year for the analysis, and all values are in real money of 1994 (US$).

Figure 2: Cost Components as a Proportion of Western World Full Operating Costs in 1994

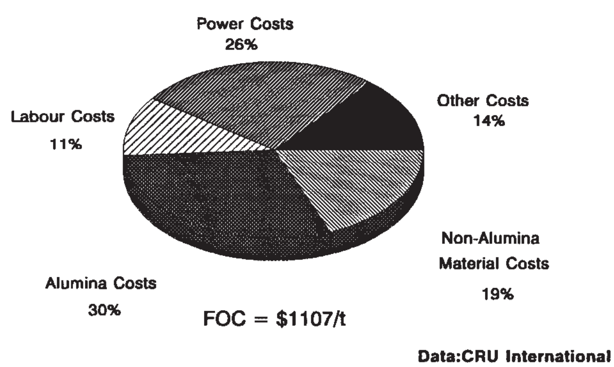

Table 2 lists the assumed operating costs for one 50,000 tpy potline at this typical smelter, in terms of dollars per annual tonne, dollars per day, and million dollars per year. The full operating cost of $1107/tonne at this smelter represents the cost when operated at full capacity, and is equal to the weighted industry average in 1994. The full operating cost for the smelter for one year would be around $221m.

Costs of Shutting Down and Restarting Potlines

Technical Aspects

Shutdown. When the decision is taken to shut a potline, it is normally preferred for each cell to be cooled with an appropriate metal level left in each pot, typically of the order of 4-12 cm. This solidified metal pad is left in the pot in order to make restarting the potline easier. In some cases as much metal as possible is removed from each pot, though this is dependent upon the smelter's desired method of restart.

During shutdown it normally takes up to a week to get the metal levels adjusted, perhaps with a proportion of pots shut down when readied, before the power is fully withdrawn.

Table 2: Assumed Operating Cost of One 50,000 tpy Potline for Representative Industry Smelter in 1994 (1994 US$)

Cost Component	$/tonne Al	$/day	$M/year
Power	287	39,315	14.35
Alumina	333	45,616	16.65
Labour	123	16,849	6.15
Bath Materials	24	3,288	1.20
Anode	89	12,192	4.45
Maintenance & Materials	60	8,219	3.00
Casthouse	30	4,110	1.50
Pot Relining	36	4,932	1.80
Overheads	69	9,452	3.45
Freight + Interest on WIP	56	7,671	2.80
Total	1,107	151,644	55.35

Anode change schedules are reduced, as are feeding schedules, and bath levels are reduced. Operating efficiency is reduced slightly during shutdown as metal and bath levels are adjusted. At this point, after the line has cooled, it is essentially mothballed, and can be left with minimal maintenance, aside from routine crane maintenance.

Startup. Once the decision is taken to restart a potline, it will take at least a month to prepare and recondition the pots, using the full complement of manpower required to operate a potline. Cleaning up the pots requires that all anodes be removed, bath and alumina cover dug out and the ledge, endwalls and sidewalls dug out. Sometimes the metal pad is removed, too. Some patching may take place in the cathode, and parts of the sidewall or endwall may be replaced. Each pot is then set up with thin layer of resistive coke on the metal pad or cathode, the anodes replaced, and an insulating cover of alumina added.

Whenever a pot is shut down (ie: cooled to room temperature) and then restarted, this can lead to a reduction in the total life expectancy of the pot. The thermal contraction and expansion of the cathode and sidewalls creates small cracks that lead to failure due to metal or bath penetration or fluoride intercalation and ultimate degradation of the cathode materials. It is difficult to define the specific potential loss of potlife, since each pot experiences a unique thermal cycle during restart. The average is typically of the order of 50-150 days per pot. Often, older pots with less than 10% of expected life remaining will not be restarted with the rest of the potline, and newly constructed cathodes will be restarted in their place.

Preparation for restart requires reconditioning of the pots. Removal of all anodes and digging out of the crust, ledges, and bath cover is required as part of preparing a pot for restart. Normally this is not done until the decision is made to restart the pot or potline since it is very labour intensive. None of the anodes can be reused, but all anode, bath, and alumina material can be separated, crushed and recovered, to be recycled back into an operating potline. Some plants restart with the remaining metal pads in place, while others elect to restart with a bare cathode. The latter requires more work in preparing the pot for restart, but assists in cathode repair, if necessary. Pot preparation labour is required to remove the metal pads, which can be recycled through the scrap stream.

During the time that the pots are being prepared, workers can be constructing new pots to replace the old ones which have been removed, and the anode plant can expand production to bring the anode inventory up to requirements. As mentioned above, the loss of operating life of pots can range from 50-150 days/pot or more, depending on the skill of the workforce at restarting potlines. Thus, new cathodes will be required to replace those pots which are nearing the end of their expected lives. This will include at least 5%-10% of all pots in a given line (perhaps as much as 40%), requiring extra effort on the part of potlining crews to prepare a line for restart.

The decision not to restart a particular pot may also depend on how it was operating before it was shutdown. Poorly operating pots are unlikely to perform better when restarted. Also, pots with new cathodes are often the last to be restarted in a potline, as more care is required during preheat, and in bringing the pot slowly up to operating temperature during bakeout, as well as during the first month or so of operation.

Potline power is brought on slowly, for even heat distribution throughout the pots. All pots in the line should take several days to heat up, to prevent excessive thermal shock to the pots. Sometimes only half to two thirds of a potline is brought on power at the start. Then, approximately 6-12 pots per day will be brought on line. This usually includes the introduction of molten bath or metal, while the anodes are raised off the cathode or metal pad.

At this point, the pot is "on line", although it will take some time to reach operational stability. Its early operation will be frequently manifested by a sudden increase in cell voltage, known as anode effect. The voltage will continue to oscillate until the right anode-to-cathode distance can be achieved, the alumina concentration is replenished in the electrolyte, and the bath and metal pad have time to settle down. Each restarted pot takes some time to stabilise and reach operating equilibrium, often taking up to three weeks to achieve this. Note that the use of molten metal or bath from other lines to assist with the restart draws on the production of those pots or potlines, where metal and bath levels suffer, resulting in lower current efficiencies.

When a pot is restarted, anode consumption is increased at first as a result of pots going into anode effect more often. In addition, the occasional prebaked anode may be lost through "hot rods" or connection problems. The total excess loss of anodes during the first week of pot operation is of the order of 5%. Metal purity losses are also encountered during the early days of a restart. Metal purity may range from 99.0%-99.7% Al for a few weeks per pot, until its operation settles down.

Costs and Commercial Aspects of Cutting Production

Costs Associated with Shutting Down and Restarting Potlines. One of the key cost elements in curtailing production for any period of time is the cost of manpower. If lay-offs or redundancies are made, a smelter is often obliged to pay compensation and redundancy payments, usually in the form of several weeks or months wages, depending on the labour contract. Also, job assignments are often allocated on the basis of seniority, so that any labour curtailment will also involve a shuffling and shifting of job assignments. This, therefore, makes necessary the training and retraining of many employees.

Alternately, if no manpower cuts are made, this leads to reduced overall labour productivity, as a result of additional overhead and labour costs per tonne of output. Some training may also be required in this case. Thus, if production is curtailed for a few months to perhaps half a year, it is usually more cost effective for a plant to maintain full employment. In cases of longer curtailments, a smelter still may be encouraged to maintain its full labour force due to local cultural, social or political conditions.

Another of the basic costs incurred during the process of shutdown is the reduced current efficiency of production. Losses in current efficiencies up to 2-5% may occur, as the emphasis is on stabilising the potline before shutdown, rather than on production. It is also possible to simply turn off the power without a managed shut-down, but then restarting is likely to be much more difficult.

Other shutdown and maintenance costs include the carrying costs of the materials in the idled pots, including metal, bath, alumina and anodes. In some cases, an idled potline can be scavenged for parts and pots to keep other potlines running, but this will then increase the cost of restarting that line.

The most significant single cost of restart is the preparation, which should take about a month. Manpower costs are highest, followed by the material costs of replacing some cathodes and all anodes. If lay-offs or redundancies have taken place when capacity was curtailed, then restarting will necessitate the hiring or rehiring, and then training of new workers. Although some of these labourers may be experienced, all will require some training and investment in safety equipment. Typically, the most highly trained potroom personnel are used to restart a potline, relying on their instinct and experience to react quickly to the difficulties which can (and will!) arise.

The Impact of Take or Pay Contracts. The costs we have calculated in this paper incorporate only the costs attributed to shutting down and restarting: they do not include the costs of sales foregone, lost production, or of purchases made to cover lost production. Neither do the costs take account of "take or pay" contracts, whereby the smelter may be bound to pay for certain inputs, such as power and/or alumina, even if it does not use them.

Take or pay contracts can indeed be an important element for a company in deciding how much capacity to cut back and at which location. If the smelter would have to pay for power it could not take, for example, the cost of shutting capacity could indeed become prohibitive. Not all smelters are affected by take or pay clauses, but many are, within a given time period before they can renegotiate terms. Their options in cutting production within reasonable cost parameters are consequently constrained.

Many smelters for example may have alumina supply deals that permit them to take 10% more or less than the base amount contracted, so that cutting production by more than 10% could become very expensive. A smelter could find itself having to resell alumina on the spot market if it is forced to take material it will not or cannot use. As an indication of the scale of costs of such an operation, one major aluminium company made a provision of US$24m in 1994, due to forced sales of alumina in response to its cutback in production. Given its cutback of 70,000 tonnes, this amounts to an additional cost of around $343 per tonne of idled metal capacity.

It is worth noting that cutbacks of supplies within integrated companies may also carry a cost, even though the supply arrangements may not be strictly on a take or pay basis. For example, a company supplying its smelters with self-generated power may not be able to sell the power elsewhere, or if it can, only at a loss. It may be able to sell at more than the rate it charges its smelter, but this is unusual. Likewise, a company which has to reduce the operating rate at its alumina refinery will incur additional fixed costs per tonne when spread across its lower alumina output.

A smelter's supply arrangement is thus critical in determining its options for cutting production cheaply. We have not factored in additional costs from take or pay contracts to our analysis, because each smelter has to be examined on a case-by-case basis, and because in many cases the information is closely guarded by the company in question. The costs could vary from zero to several hundred dollars per tonne of idled capacity.

The costs or benefits of having to cover lost production are also only able to be assessed on a case-by-case basis. In certain circumstances, a smelter could make a gain by buying back its forward sales at a lower price, thus offsetting the cost of cutbacks. However, market conditions in 1994 meant that many companies which had made cutbacks were forced to buy from the market at rising LME prices and rising merchant premiums.

The results we report are therefore "pure" shutdown and restart costs. Costs of buying back production or costs resulting from supply arrangements are not included. Some smelters may be able to alter their inputs by plus or minus 10% without incurring large costs, but beyond this level, costs could rise steeply, and suppliers could enforce take or pay clauses.

The Costs of Cutting Production At A Representative Industry Smelter

The costs for the representative smelter (previously described) have been determined for three scenarios in which production can be cut. Note again that costs of buying replacement metal or costs resulting from interruptions to supply arrangements are not included.

Reducing Amperage and Idling Selected Pots

A smelter does not have to shut a whole potline in order to reduce production significantly. It is possible to do so by eliminating a few pots or part of a line from production or by reducing amperage to the whole line or plant. At some companies for example, cutbacks announced under the MoU have obligated smelters to reduce production. The smelters have done so by reducing amperage or by taking out selected pots rather than shutting down a potline.

Table 3: Costs of Reduced Amperage & Few Idled Pots at Representative Industry Smelter (10% capacity reduction)

Cost Component	Cost ('000$)	Cost ($/t idled)
Lost Pot Life (50 days/6.5 pots)	10	0.50
Carrying Cost of Materials (@6%)	8	0.40
Labour Cost (10% of total)	615	30.75
Maintenance & Materials Cost (10% of total)	300	15.00
Overhead Cost (10% of total)	625	31.25
TOTAL	1,558	77.90

Table 4: Costs of Shutting Down a Potline at Representative Industry Smelter (50,000 tpy capacity)

Cost Component	Cost ('000$)	Cost ($/t idled)
Lost Production During Shutdown (2% for 1 week)	35	0.70
Labour Redundancy Costs (150 Employees @ 4 weeks severence pay)	277	5.54
Labour Retraining Costs (300 Employees @ 1 day's wages)	28	0.56
Costs of Lost Anodes, Bath, Alumina	34	0.68
Lost Pot Life (50 days/pot = 3.25 pots)	225	4.50
TOTAL	599	11.98

The pots taken off line are usually those which are old or not operating well, and will have to be replaced soon anyway, minimising the cost impact. Thus, the potlife of a few pots is reduced by a few tens or hundreds of days, for a total cost in the range of one or a few pot rebuilds.

Reducing the amperage on a potline affects operations very little aside from reducing metal production (once adjustments are made to maintain the proper heat balance in the cells). Reducing line amperage may, in fact, assist in improving current efficiency slightly as a result of the required operating adjustments necessary to operate at a lower current.

However, there are technical limits to the degree that amperage can be reduced, or to the number of pots that can be taken out of a line while retaining efficiency. It is necessary to balance the thermal requirements of each cell as well as the total voltage of each line in order to operate efficiently. CRU believes that a maximum potential reduction in amperage of around 12-15% only is feasible, before the thermal distribution in the pots reaches unacceptable levels. In addition, by taking out selected pots, rectification and line voltage controls will be pushed further towards their operating limits. As a result, we believe it is unlikely that more than 20-25% of a smelter's total capacity could be reduced by these measures alone, without resorting to shutting down a potline.

The costs of reducing amperage are directly related to reduced production, resulting in lower labour productivity per tonne, and thus higher overheads and higher operating costs per tonne of metal produced. The advantage of reducing capacity in this way is that it can be brought back on line very quickly, without the large costs and difficulties of restarting potlines. If longer-term capacity reduction is desired, however, CRU believes that it is more cost effective to shut a potline.

The costs of shutting capacity by reducing amperage or by taking a few select pots off-line are detailed in Table 3. The main cost components are those associated with maintaining increased labour, maintenance, and overheads per tonne of output. CRU estimates a cost of approximately $1.56m per year for maintaining production at 10% below capacity for one year. This is equivalent to nearly $78 per tonne of idled capacity per year.

Shutdown of a Potline, with Restart After Many Months

A more common situation involving idled capacity is when a potline or part of a potline is taken out of service. We have analysed this in terms of the costs of shutdown (see Table 4); maintainance of idled capacity (Table 5), in this case for one year; and of the subsequent restart (Table 6). Although these costs are divided into three descriptive groups, the total cost of restart is the most important, as many of the costs would not occur if restart was never intended.

The primary cost component of shutting a potline is the labour redundancy payments. In this case, we have assumed that 150 potline labourers are made redundant, at an average of four weeks severance pay. The cost is $277,000. Smaller, but not insignificant costs include the lost production due to reduced current efficiency during the week of shutdown, and the irrecoverable costs of materials. Also included here are the costs of lost potlife (conservatively taken here as only 50 days per pot) which will be incurred once the pots have been restarted. Table 4 shows the cost of closing a 50,000 tpy potline at around $600,000, or $12 per tonne of capacity idled.

Maintaining a smelter at less than full capacity has significant cost drawbacks in terms of additional labour, maintenance, and overhead costs. Even with 150 potroom labourers made redundant, the overhead, maintenance, and labour costs per tonne of remaining production will still be higher than that of operating at full capacity. In addition, there is the carrying cost of the metal, anodes, and bath materials in each pot, figured at their original value at shutdown.

Table 5: Costs of Maintaining Idled Potline (50,000 tpy) for a Year at Representative Industry Smelter

Cost Component	Cost ('000$/yr)	Cost ($/t idled)
Routine Crane Maintenance	20	0.40
Carrying Cost of Metal (@6%)	60	1.20
Carrying Cost of Bath, Crust, Anode Materials (@6%)	30	0.60
Labour Cost (11.76% of total)	723	14.46
Maintenance & Materials Cost (18% of total)	540	10.80
Overhead Cost (25% of total)	1,563	31.26
TOTAL	2,936	58.72

Table 6: Costs of Restarting a Potline (50,000 tpy capacity) at Representative Industry Smelter

Cost Component	Cost ('000$)	Cost ($/t idled)
Potline Preparation: Labour (150 Employees, 1 month)	308	6.16
Potline Preparation: Materials	15	0.30
Reduced Efficiency at Start (2%, 1 week)	35	0.70
Reduced Efficiency of Other Pots/Lines (0.25%, 1 month)	56	1.12
New Pots (3.25 Pots > 1950 days old)	225	4.50
New Anodes (Each Pot)	146	2.92
Training/Overheads	45	0.90
TOTAL	830	16.60

Approximately 550 tonnes of solidified aluminium will be held in the 150 pots of our representative idled potline, taken at 8 cm per pot, and inaccessible for sale or barter. Assuming the price of aluminium does not change during the year, the carrying costs have been calculated at modest interest rates to be $60,000 for the aluminium, and half that for the other materials in the potline.

Table 5 shows an estimated total cost of $2.9m per year, or of $59/t of idled capacity, for maintaining one idled potline with some reduced labour. Rather than allocate the overheads and labour across the remaining capacity, in this exercise note that we have presented costs in terms of dollars per tonne of idled capacity. In this way, the costs can more easily be used as a benchmark for shutdowns of various amounts of capacity.

When restarting, at least a month of work is required to prepare the potline, at a cost of $308,000, using the same labour that would normally be used to operate the potline. Other costs include the costs of replacing the pots which are too old to be restarted, and the labour costs of new anodes for each pot, bearing in mind that none of the old anodes can be reused directly, but require recycling. Costs of reduced operating efficiency include the pots in the restarted line which take 2-3 weeks to settle down, and the pots in adjacent lines which are being tapped of metal and/or liquid bath to help with restarting the new line. Other costs which will be incurred are those related to operating materials, safety equipment, re-establishing supply and sales contracts, and training/retraining programs. Table 6 shows the costs for restarting the potline previously closed down.

Table 7 summarises the total costs of the whole cycle of shutting down, maintaining idled capacity, and restarting a potline at the representative smelter. Our estimated total cost is $4.4m in the case of one 50,000 tpy idled potline for one year, with some workforce reduction during that time. Expressed in terms of costs per tonne of idled capacity, the figure is $87.3 per tonne idled.

Shutdown of a Potline, With a Restart as Soon as Possible

As a final cost scenario involving cutbacks, there may be instances where acts of nature, sabotage, or force majeure cause a smelter to close a potline quickly and unexpectedly. In this case, every care is taken to assure that the pots can be stabilised while they cool down, but nothing can be done to assure stable metal levels are attained, nor adjustments made of bath levels, anodes, or alumina cover.

Where the potline is to be brought back on line as quickly as possible, labour redundancies and additional overheads are not necessary. If preparations began immediately after shutdown, we estimate that it would take over a month before the line could be restarted. In Table 8 the total costs are estimated to be $1.052m (falling into line with the traditional belief that it costs at least $1m to shutdown and restart a potline). That is equivalent to $21 per tonne of idled capacity.

Summary and Assessment of the Costs By Type Of Cutback

As a summary of the different cost scenarios, Table 9 presents the costs of each idled capacity situation, in terms of total costs and as a cost per tonne of rated capacity of the smelter. These costs include only the costs attributed to shutting down and restarting. They do not include the costs of lost production.

At the representative industry smelter described here, reducing amperage and capacity by 10% will increase the full operating costs of the smelter by $7.8/tonne per year. Shutting down one potline and restarting it after a year will increase the smelter's full operating costs by $21.8/tonne for that year. A shutdown with a quick restart will increase the yearly full operating costs by $5.3/tonne.

Assessment of Options Facing Producers:
Reducing Amperage vs Potline Shutdown

When a smelter is faced with the necessity of reducing

Table 7: Total Costs of Shutting Down and Restarting a Representative Industry Potline of 50,000 tpy after One Year

Cost Component	Cost ('000$)	Cost ($/t idled)
Costs of Shutting Down a Potline	599	11.98
Costs of Maintaining Idled Potline	2,936	58.72
Costs of Restarting Potline	830	16.60
TOTAL	4,365	87.30

Table 8: Costs of Shutting Down and Quickly Restarting a Representative Industry Potline (50,000 tpy capacity)

Cost Component	Cost ('000$)	Cost ($/t idled)
Costs of Lost Anodes, Bath, Alumina	34	0.68
Lost Pot Life (50 days/pot = 3.25 pots)	225	4.50
Carrying Cost of Metal (6%)	5	0.10
Carrying Cost of Bath, Crust, Anode Materials (6%)	3	0.06
Potline Preparation: Labour (150 Employees, 1 month)	308	6.16
Potline Preparation: Materials	15	0.30
Reduced Efficiency at Start (2%, 1 week)	35	0.70
Reduced Efficiency of Other Pots/Lines (0.25%, 1 month)	56	1.12
New Pots (3.25 Pots > 1950 days old)	225	4.50
New Anodes (Each Pot)	146	2.92
TOTAL	1,052	21.04

production, the options are to either shut a potline or merely reduce amperage for some time. Operating at reduced amperage has the advantage of no shutdown or restart costs, but requires that additional labour and overheads be carried for each tonne of output. Also, the total amount of capacity that can be effectively idled in this way is limited to about 20-25% of total capacity. Beyond that, it becomes very difficult to maintain the proper heat balance within the operating pots, and production will suffer significantly.

Based on the calculations made earlier, we believe that the decision to reduce amperage is more cost effective for the smelter than shutting a potline up until approximately 18 months of shutdown. After that, the cost of maintaining a full workforce and the associated additional overheads cause the costs to rise enough to overtake the costs of operating with a potline shut down.

The Time Required to Restart Closed Capacity

Five scenarios have been envisaged concerning the amount of time required to bring capacity back on-line, depending upon the amount and the way the capacity has been shut. Together they should encompass most types of capacity curtailment, ranging from the quickest restart to the slowest. The scenarios range from a few weeks necessary to restart some types of cutback to half a year or more for a much more significant restart. Most plants would probably fall under Scenario 3, where they would be expected to restart capacity in 2-2½ months.

Scenario 1: Reduced Amperage and/or Selected Pots Off-line

The first scenario considers a plant which has reduced capacity by either reduced amperage or just eliminating a few pots or both. This is likely in the case when production has been curtailed by 10%-15% or less. Presumably, manpower will not have been reduced at this smelter, with potline operation carrying on as normal. Pots not on line can be prepared for restart with ease and thus would be ready to restart once the decision is made. Restarting will take a matter of a few days or weeks, for all the capacity to be back on line. Time requirement: 2-3 weeks.

Scenario 2: Potline Closed; Pots Already Prepared for Restart

In the second scenario, the plant has shutdown a potline with the intention of restarting whenever conditions are ripe. Pots will have been prepared for restart, with anodes, bath and alumina at the ready. Line could be restarted and operating efficiently in less than a month from the time the decision is made to restart. The time is required to bake out and bring on stream all pots, and then give them a week or so to settle down and produce low impurity prime. Certainly some addition production can begin in about a week, with full capacity and full efficiency achieved in a month. Time requirement: 1-1½ months.

Scenario 3: Potline Closed; Pot Preparation Needed

Probably more typical is scenario three, where a plant has shut down a potline and laid off workers. The potline is basically

Table 9: Total Cost Exposure of Shutting Down and Restarting Capacity at Representative Industry Smelter

Scenario	Cost ('000$)	Cost ($/t capacity)
1. Costs of Reduced Amperage & Some Idled Pots for One Year (10% cut)	1,558	7.790
2. Costs of Shutting Down a Potline	599	2.995
Costs of Maintaining Idled Potline One Year	2,936	14.680
Costs of Restarting Potline	830	4.150
Total Costs of Shutting Potline and Restarting in One Year (25% cut)	4,365	21.825
3. Costs of Shutting Down and Quickly Restarting a Potline (minimal loss)	1,052	5.260

"mothballed" and left as it is, unattended, with only routine crane maintenance. When the decision is made to restart, labour needs to be brought back (1 week), the potline prepared by digging out anodes and bath, etc. (1 month), and then restarted. During line preparation time, the anode plant and potlining can catch up with needs of that line. Restart itself takes 1 month, with some time required to get up and running smoothly, and for training/retraining of potroom workers. Time requirement: 2-2½ months.

Scenario 4: Potline Closed and Partly Cannibalised

In some cases, a plant may have shutdown a potline for some time and have started robbing it of spare pots and parts. In this fourth scenario, restarting will be similar to the previous case, except another 2-4 weeks required for additional potlining and maintenance to become fully operational, with additional training of potroom personnel. Time requirement: 3-4 months.

Scenario 5: Complete Plant Shutdown

In scenario five, a plant has shut down completely and needs to restart wholly or partly. Maintenance, labour, and staff need to be hired/rehired (4 weeks min.). Anode plant, transfer equipment, cranes, baghouses, potlining, rectifier, etc. all need to come up to operational standards (2 months) while potline(s) are prepared. Potlines will come on stream more slowly, without molten metal and bath to assist (6 weeks). More time will be needed to iron out the bugs and get pots running at good purity and good efficiency. Time requirement: 5-6 months.

References

1. Primary Aluminium Smelting Costs to 1997, Aluminium Cost Service 1994-1995, CRU International Limited, pp 79-96.