producingresults

Tube Mill Economics 102

It's the plan that makes success!

By W.B. "Bud" Graham,
Contributing Writer

Baseball fans thrive on statistics. During a game the announcers rarely go more than a few moments without reciting a player's batting average, discussing his total number of hits or home runs, or discussing some other statistics.

Statistics can be helpful in the practice of tube production planning too. Please note I purposely used the term *practice* because this is what you do every time you set up a mill or manufacture a lot of tube. The idiom "Practice makes perfect" applies to successful baseball players and tube mill operators. Learning the fundamentals, applying the knowledge gained from experience, and playing your heart out are the key ingredients for playing a good game or accomplishing a good tube run.

Be aware, though, that no amount of practice can compensate for circumstances beyond your control. In baseball, a primary factor beyond the players' control is rain, which often causes a rain delay. In tube production, the production department and management often share the responsibility for a delay.

Delays can be caused by:

1. Management's failure to provide adequate spare parts inventory so equipment can be repaired expeditiously. You're at fault if you did not identify the problem and place the parts on order for your department.
2. Management's failure to schedule sufficient time for preventive maintenance. You create the schedules, so this is a shared responsibility.
3. An inadequate supply of raw material or inefficient material inventory ordering processes. The responsibility for this probably isn't 50/50. This is largely an upper-management responsibility, but you're not off the hook if you notice inadequacies and inefficiencies but fail to communicate them.
4. Inadequate in-process storage or attempts to operate in a manner inappropriate to the changeover capabilities of the tube mill.
5. Lack of planning or communication between sales and production personnel; promising unrealistic delivery dates; or accepting orders for any size without thought of inventory on hand.

Let's Talk Stats

The best batters get a hit only about 25 percent of the time, thus earning batting averages around 0.250. But this statistic does not tell the story as well as a player's on-base percentage (OBP), which is calculated as follows:

(Hits + Walks + Hit by Pitch) / (At-bats + Walks + Hit by Pitch + Sacrifice Fly Balls)

This method is better but does not take into account how the total number of bases reached adds value. After all, the player who can reach more bases per hit has a bigger influence on the final score. Influencing the final score (or, stated another way, reducing the role of chance in the game's outcome) is every player's goal. By the same token, every tube mill operator's goal is to reduce the role of chance in the tube mill's output.

Applying a Game-winning Strategy in a Tube Facility. Learn to make decisions based on facts, not just instructions; apply strategy to win the game. This means it's necessary to communicate frequently up and down the chain of command to produce tube at the lowest possible cost based on the facility capability (mill, tools, maintenance condition, and so forth) and personnel skill level.

Need advice on strategy? Find a mentor. Knowing what you don't know is strength, because then you can develop a plan to acquire the information or skills needed to succeed.

Plan production schedules based on the chance of success (COS), and base your performance on your earned run average (ERA), which can be calculated with the following formula:

Number of Feet of Good Tube Produced / Labor-Hours

Making a Schedule. It's Monday morning and it's time to set up the schedule for next week. How do you decide what to run first? To illustrate

Typical Production List in Order of Delivery

Tube OD	Wall Thickness	Production Footage
1.000	0.028	45,000
1.250	0.049	38,000
1.375	0.058	35,000
1.250	0.042	25,000
1.875	0.049	46,000
1.250	0.058	42,000
2.000	0.035	95,000
1.000	0.035	52,000
1.875	0.058	55,000
2.000	0.042	65,000

Figure 1

the example, we use a typical production list (see **Figure 1**). This list is typical for small production shops; the list is based on the order of delivery, not in the order for production.

How can you manufacture these sizes economically? First, sort the list by OD. Arrange the list so you can see common OD groupings (that is, group common ODs together) and the OD progression (OD changes). See **Figure 2**. This sorting method lets you see the possibilities of reducing the mill changeovers by doing wall thickness changes only or by using your combined breakdown tool set capability. The breakdown tool set is key to reducing changeover time because it doesn't need to be changed every time you change to a different OD. Unlike the other tool sets, which are specific to a particular OD, the breakdown set can be used on a range of ODs.

Now expand the list so you can see your production, raw material, and labor requirements. **Figure 3** shows the number of slit coils and the run time the tube mill needs to produce the desired amount of tube. Use the slit coil requirements to check inventory or order raw material. Use the feedback on raw material as an input for COS and use your own experience—or better yet, your crew's experiences—to run the COS comparison.

Scaling All the Factors. We're not done yet. Now we need to give some careful thought to all the variables or factors that go into a tube production run. We need to give all of the factors a COS rating from 1 to 10 (1 being the lowest, 10 being the highest).

In this example, the material availability is a concern, especially for these sizes: 1.00 inch OD by 0.028 in. wall thickness, 1.250 in. by 0.049 in., and 2.00 in. by 0.035 in. Therefore, these sizes are rated less than 10. See **Figure 4**.

The 1.250-in. roll tools are just back from regrind so they rate a 10. All other roll tooling has reduced reliability because of wear, and you expect more difficulty in setup, so the COS rating drops. You have done your homework on the mill and there are no reliability issues, so this is rated a 9. The production list includes two sizes (1 in. by 0.028 in. and 1.375 in. by 0.058 in.) that you don't run frequently, so the experience level for these sizes is a 5.

The mill speed for each product also is a factor. Products that run faster earn a higher score. Finally, tube made for stock earns a 10, whereas tube made for a special order earns a lower score.

Getting the Batting Order Just Right

Even if you have a whole team of solid batters, optimizing the team's results at bat depends on the batting order. It's no different in a tube mill. You could have the best setup guys and mill operators in the business, but all their skill and experience won't help you manufacture tube efficiently if the production order is not optimized. After you have assigned each run a COS, you need to order the runs correctly.

Sorted Production List

Tube OD	Wall Thickness	Production Footage
1.000	0.028	45,000
1.000	0.035	52,000
1.250	0.042	25,000
1.250	0.049	38,000
1.250	0.058	42,000
1.375	0.058	35,000
1.875	0.049	46,000
1.875	0.058	55,000
2.000	0.035	95,000
2.000	0.042	65,000

Figure 2

Some guidelines for achieving the most efficient production are:

1. Whenever possible, eliminate tool changeovers. Schedule production so that a single set of tooling is used on as many production runs as possible. Do this by scheduling production runs of common ODs consecutively. In other words, group tube by the OD.

2. Within each OD group, schedule the tube runs in descending COS order. That is, start with the highest COS.

3. If two production runs have different ODs, select the next size to be run based on the combination breakdown capability of the roll tools.

4. If no commonality in OD or tooling exists between two production runs, schedule the run that has the highest COS score first.

5. Follow combination tool setup (common breakdown tool usage) through the available tube OD ranges.

6. If possible, schedule production so that you finish this week's work with the tool set you'll need at the beginning of next week.

Using the product sort and the

Tube OD	Wall Thickness	Desired Footage	Coil OD	Coil ID	Coil Footage	Coil Footage Converted to Number of Coils	Number of Coils Selected for Run	Actual Run Footage	Weld Speed (FPM)	Calculated Run Time (Hours)
1.000	0.028	45,000	72	22	10,986	4.10	5	54,931	325	2.817
1.000	0.035	52,000	72	22	8,789	5.92	6	52,734	325	2.704
1.250	0.042	25,000	72	22	7,324	3.41	4	29,297	325	1.502
1.250	0.049	38,000	72	22	6,278	6.05	7	43,945	325	2.254
1.250	0.058	42,000	72	22	5,304	7.92	8	42,430	310	2.281
1.375	0.058	35,000	72	22	5,304	6.60	7	37,126	310	1.996
1.875	0.049	46,000	72	22	6,278	7.33	8	50,223	290	2.886
1.875	0.058	55,000	72	22	5,304	10.37	11	58,341	285	3.412
2.000	0.035	95,000	72	22	8,789	10.81	11	96,679	250	6.445
2.000	0.042	65,000	72	22	7,324	8.87	9	65,917	250	4.394

Figure 3

The total run footage is 531,621 ft. The total run time is 30.692 hours.

Tube OD	Tube Wall	Tooling Change Necessary? (No = 10)	Raw Material Available? (Yes = 10)	Roll Tool Condition (Good = 10)	Mill Condition (Good = 10)	Skill Level (More Experience = 10)	Mill Run Speed (Faster = 10)	Run for Stock or Special Order? (Stock = 10)	Cumulative COS Score
1.000	0.028	10	5	6	9	5	10	5	50
1.000	0.035	10	10	6	9	10	10	10	65
1.250	0.042		10	10	9	10	10	10	59
1.250	0.049		5	10	9	10	10	10	54
1.250	0.058		10	10	9	10	10	10	59
1.375	0.058		10	7	9	5	9	1	41
1.875	0.049	10	10	9	9	10	8	10	66
1.875	0.058	10	10	9	9	10	8	10	66
2.000	0.035		7	7	9	10	7	5	45
2.000	0.042		10	7	9	10	7	5	48

Figure 4

Rate every factor or variable on a scale of 1 to 10 to determine the chance of success (COS) of running production efficiently. On this scale, 1 indicates the lowest chance of success, and 10 indicates of highest chance of success. Note: In this scenario. 1-in. tooling is already on the mill, so a tooling change is not necessary to begin production.

COS scores generates a production schedule shown in **Figure 5**. If you had run production as requested in the original order, the schedule would have looked like the one in **Figure 6**.

The COS process has led you to a projected changeover time of 8.25 labor-hours to accomplish the desired production. If you had run production in the original order, the changeover time would have been 16 hours. Using the COS process cut changeover time by nearly 50 percent. The COS also cut the overtime. The work week would have been 44.07 hours if you had simply followed the original schedule, but using the COS approach cut the workweek to 40.20 hours. Furthermore, this approach helps you save time right off the bat next Monday because you should be able to start next week's production with the tooling used at the end of this week's production.

Figure 7 compares the two sets of production statistics.

Apply reason to production methods to increase the chance of suc-

Run Order Based On COS	Tube OD	Wall Thickness	Production Footage	COS Score	Rolls Requiring Adjusting or Changing	Changeover Time (Labor-Hours)
1	1.000	0.028	45,000	50	None	0.000
2	1.000	0.035	52,000	65	EG/Fin/WB	0.250
3	1.250	0.042	25,000	59	EG/Fin/WB/Siz/TH	1.500
4	1.250	0.049	38,000	54	EG/Fin/WB	0.250
5	1.250	0.058	42,000	59	EG/Fin/WB	0.250
6	1.375	0.058	35,000	41	EG/Fin/WB/Siz/TH	1.500
7	2.000	0.042	65,000	48	All	2.000
8	2.000	0.035	95,000	45	EG/Fin/WB	0.250
9	1.875	0.049	46,000	66	All	2.000
10	1.875	0.058	55,000	66	EG/Fin/WB	0.250

Figure 5

A schedule based on COS leads to a total changeover time of 8.25 hours. Note: In this scenario, 1-in. tooling is already on the mill, so a tooling change is not necessary to begin production. The mill is manned by two operators and a material handler. A single breakdown tool set is used for tube in the 1- to 1.5-in.-OD range and another set is used for tube in the 1.5- to 2-in.-OD range. EG = Edge Guide, Fin = Fins, WB = Weld Box, Siz = Sizing, TH = Turk's Head

Run Order Based on Delivery Schedule	Tube OD	Wall Thickness	Production Footage	Rolls Requiring Adjusting or Changing	Changeover Time (Labor-Hours)
1	1.000	0.028	45,000	None	0.000
2	1.250	0.049	38,000	EG/Fin/WB/Siz/TH	1.500
3	1.375	0.058	35,000	EG/Fin/WB/Siz/TH	1.500
4	1.250	0.042	25,000	EG/Fin/WB/Siz/TH	1.500
5	1.875	0.049	46,000	All	2.000
6	1.250	0.058	42,000	All	2.000
7	2.000	0.035	95,000	All	2.000
8	1.000	0.035	52,000	All	2.000
9	1.875	0.058	55,000	All	2.000
10	2.000	0.042	65,000	EG/Fin/WB/Siz/TH	1.500

Figure 6

A schedule based on delivery results in a total changeover time of 16 hours. Note: In this scenario, 1-in. tooling is already on the mill, so a tooling change is not necessary to begin production. The mill is manned by two operators and one material handler. EG = Edge Guide, Fin = Fins, WB = Weld Box, Siz = Sizing, TH = Turk's Head

	Production Based on COS Projection	Production Based on Delivery Schedule
Material Consumed (tons)	191.33	191.33
Good Tube Produced (ft.)	505,040	505,040
Work Hours Required	120.60	132.00
ERA for Period	4,188	3,820
Average Workweek (hours)	40.199	44.074
Overtime per Person (hours)	0.199	4.074
Mill Uptime (percent)	80.35	65.25

Figure 7

These two production scenarios result in the same footage of good tube. However, basing the production schedule on the COS projection decreases the labor-hours needed to produce each foot of good tube (which increases the ERA) and increases the mill uptime.

cess. Make a production plan based on your resources. Communicate with management and employees. Operate with your plan for success and the week will be easier and more profitable. Do it and you'll become your company's MVP.

Bud Graham is president of Welded Tube Pros, P.O. Box 202, Doylestown, OH 44230, 330-658-7070, fax 312-896-5696, budg@bright.net, www.weldedtubepros.com. He also is the chairman of TPA's Tube Producers Council. Welded Tube Pros is a consulting engineering firm serving the needs of welded tube producers. If you have a specific question or would like to see an article on a particular problem, please contact the author or TPJ.