New Blender, Old Facility:

How different blenders interact with the existing facility: an industry case study.

Improve efficiency. Reduce waste. Increase throughput.

Existing facilities are starting to feel their age.

Shutting down for a full modernization is not an option. This is a case study of a busy OSD facility that sought to improve its operations by upgrading just the blending unit operation. This options analysis highlights how new or different technology can significantly improve existing operations.

THE GOAL

The existing procedure:

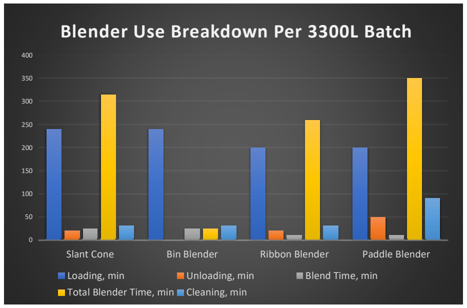
- Dispense and kit all ingredients
- Transport to blender room
- Lift to platform
- Manually pour through sieve into 1500L or 2000L slant-cone blender
- Blend
- Empty blender into multiple IBCs
- Remove to tableting
- Attach mobile CIP cart and clean

New blender should:

- Eliminate kitting and manual loading with pneumatic conveying
- Have a high batch-size flexibility
- Have redundancy for optimal throughput
- Be compatible with a wide range of powders
- Minimize cost
- Minimize downtime
- Minimize changes to existing procedures
- Utilize CIP

#	Option Elements	Slant Cone	Bin Blending	Vertical Ribbon	Paddle Blender
1	Compatible with pneumatic conveying	1	2	3	3
2	Batch size flexibility	1	1	3	3
3	Invite redundancy	3	3	1	2
4	Spatial efficiency	1	3	3	1
5	Processing time / downtime ratio	2	3	1	1
6	Cost for blender(s)	N/A	2	1	2
7	Production flexibility	1	3	2	2
8	Change to existing procedures	3	1	3	3
9	Ease of Cleaning	2	3	3	1
	Total	18	21	20	19

Rubric rating each blender by selection criteria. A higher number corresponds to a better fit. Highest score represents the option that is best match.



The longer loading time for the diffusion blenders is based on the existing "layering" loading requirement. The convection blenders do not require layering. Bin blender loading time was not included in the total time-in-use for the blender, since the blender itself is not in use when the IBC is being filled. However, three IBCs were required to be blended separately to make up a 3300L batch, whereas the other blenders were able to do it in one or two blend cycles.

RESULTS

The Client was not afraid to revalidate their process for the right blender. However, they had a CMO currently making their products using a paddle blender. This meant that all diffusion blenders and convection blenders were SUPAC equivalents of their existing process.

The following blenders were selected for comparison:

- Bin blender
- Paddle blender
- Vertical ribbon blender

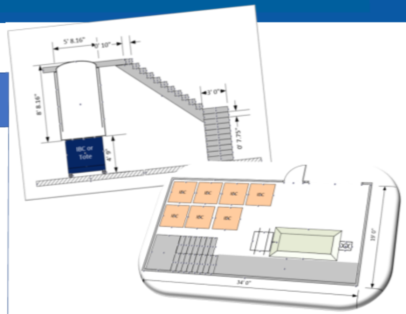
The results were tallied in the table to the left. A high total score corresponds to a better match.

From the standpoint of efficiency, the results were strongly in favor of vertical ribbon. The system was quick, could handle a range of batch sizes, was easy to load via pneumatic transfer, easy to clean via permanent CIP connection, and easy to unload into bins. Unloading did take time; the larger the batch, the more bins needed to be rolled in, staged, connected, disconnected, and removed from the room.

Bin blending was the other front-runner. A single post blender could handle a rapid series of batches of many sizes. There was virtually no unloading time. The infrastructure for cleaning and moving bins, as well as bins of various sizes already existed in the facility. Redundancy was cheapest and least spatially demanding.

The main downside was that new space would be required to charge the bins. However, this could be readily arranged in the extra space saved by the small blender footprint.

PADDLE BLENDER



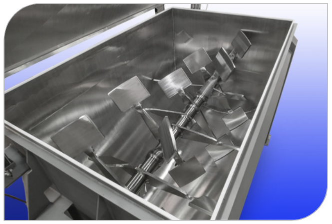
Procedure would be roughly the same as with the existing slant-cone blender. Lower blender profile means a taller bin can fit underneath. However, large IBCs have ergonomic and staging drawbacks. The Client preferred to proceed with their existing 600L IBCs. This provided a basis for modeling processing time and staging requirements.

Floor layouts were used to estimate area requirements for each blender. A "blend capacity per square foot" number was calculated, but ultimately discarded as too reductive. Rather, the best fit relative to the existing rooms was highlighted.

The primary drawback of the paddle blender studied was lack of CIP capability. The extra turnaround time and manpower requirement made it appear more of a step back than an upgrade. Making it compatible with pneumatic transfer would also have required extra customization.

Blender capacity, L	Total processing time, min	600L Bins needed	Blenders required
2712	184	5	1.5
3384	204	6	1.4
4078	225	7	1.2
4730	245	8	1.17
5423	276	10	1.14
6116	296	11	1.09
7340	327	13	1.0

Blender size selection is based on optimizing for total system footprint. This included a tradeoff between larger batch size and larger bin staging requirement. Blenders were sized to have a both slack and redundancy to prevent bottlenecks and ensure continuity.

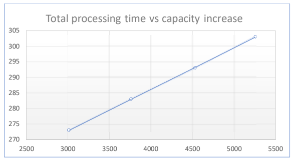


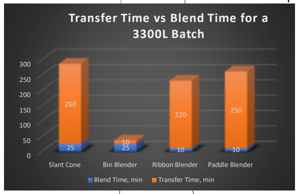
VERTICAL RIBBON BLENDER

A large benefit of the convection blenders is that they do not move while blending. This means they can host permanent connections for CIP and pneumatic conveying. Access to the top is limited to routine maintenance only.

The ribbon blender has the fastest blend time. However, that benefit is subsumed by the amount of time it takes to empty the blender for turnaround. As the batch grows, processing time grows, as does the amount of staging space required. This is the trade-off that was analyzed to find the optimal blender size.

While a single blender *could* process the largest batch in a single go, the reduction in flexibility (by having only one blender) was not feasible for a facility with so many products, many with small batch sizes. At the same time, the ribbon blender was the priciest option, making redundancy prohibitive. That is ultimately what made this blender unpalatable to the Client.





The largest time demand is powder transfer. The larger the batch, the more bins were needed to carry the batch away, the longer the unload time. The convection blenders had the lowest actual blend time, but due to long unloading times, had an overall high in-process time. Eliminating transfer time provides the largest boost in batch efficiency.

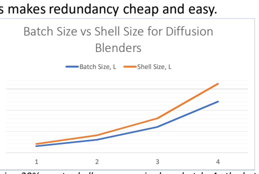
BIN BLENDER

Benefits: Since charging, discharging, and cleaning happen remotely from the blender, turnaround is faster and operations are more flexible. Spatial requirements are the same as for a standalone blender; instead of being in one room, they are in three (dispensing, blending, cleaning).

While the batch size flexibility of a diffusion blender is low (40-70% shell fill compared to 15-90% for convection), a single blender can handle a range of shell sizes. The tradeoff is storage of shells out of process. However, extremely large shells are associated with a number of challenges, so batch sizes above 1200L will have to be broken up.

Most OSD facilities use IBCs in some capacity. If the blender is compatible with existing IBCs, "bin proliferation" is less of a concern. And the infrastructure for washing and moving bins already exists.

The cost of a post blender was the lowest of all blenders examined. Post blenders also had the smallest footprint. This makes redundancy cheap and easy.



Assuming 30% empty shell space required per batch. As the batch size increases, the diffusion blender allocates more precious square feet to empty space.