FEASIBILITY OF POWDER LAYERING IN BOTTOM-SPRAY FLUID BED FOR SUSTAINED-RELEASE PELLET MANUFACTURING

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PURPOSE

The aim of this study was to investigate the feasibility of performing powder layering in a conventional bottom-spray fluid bed equipped with Wurster Pro™ technology, exploring its potential as an alternative approach for sustained-release multiparticulate manufacturing. This unconventional application was compared with standard aqueous ethylcellulose spray coating to evaluate process behaviour, pellet characteristics, coating quality, and resulting drug release performance.

OBJECTIVES

- Evaluating the feasibility of running a powder layering process in Fluid Bed (bottom spray configuration).
- Confront suspension coating and powder layering processes in Fluid Bed (bottom spray configuration).

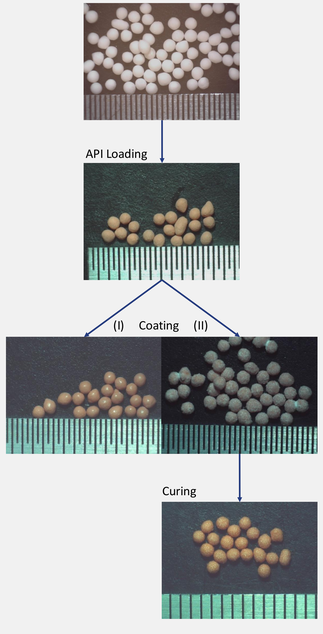
METHODS

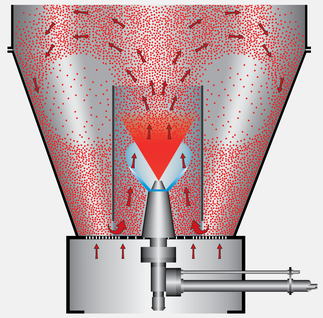
Sugar Spheres (Suglets® 16/18, Colorcon)
Were loaded with Paracetamol using an HPMC (Vivacoat®, JRS) Suspension.

Pellets were subsequently coated with ethylcellulose using two approaches: (I) aqueous dispersion coating (Surelease®, Colorcon, 15% solids) in bottom spray with Wurster Accelerator gun reaching 15% w.g., and (II) powder layering using ethylcellulose powder (Ethocel™ HP 10, Roquette) with a plasticizing solution (triethyl citrate-based at 30% concentration) delivered through Wurster Pro® technology reaching 28% w.g..

Curing was conducted at different time and temperature conditions in static oven.

STEPS





Bottom spray functioning scheme

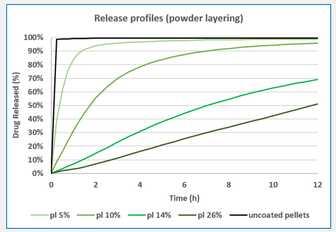


Standard accelerator system vs Wurster Pro™



FC-LAB 3 FLO-COATER®
Laboratory Scale Fluid Bed Dryer

RESULTS

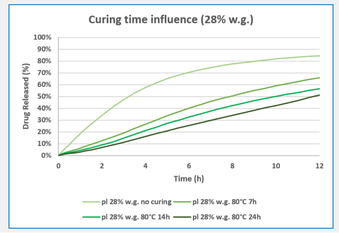


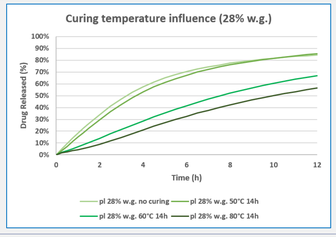
COATING THICKNESS INFLUENCE:

The graph shows a direct correlation between the film thickness (measured as weight gain) and the release profile of the API, with higher w.g. leading toward slower release of the drug from the coated core.
This correlation is true for both suspension coating and powder layering processes.

CURING TIME INFLUENCE:

The graph shows a correlation between curing time and release profile.
The non-cured sample has a faster release rate, compared to the cured ones.
The longer the curing process, the slower the release rate.



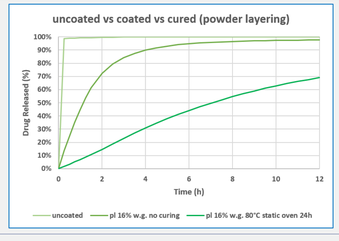


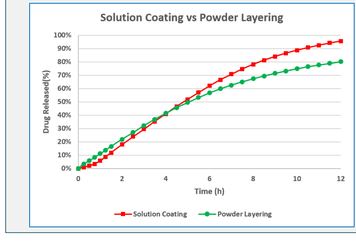
CURING TEMPERATURE INFLUENCE:

The graph shows that performing curing at 50°C doesn't impact on the release profile, which remain almost identical to the non cured, suggesting that higher temperaures are required.
Infact at 60 and 80°C the release rate gets slower.

UNCOATED VS UNCURED VS CURED:

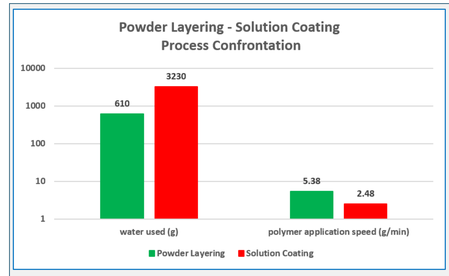
The graph shows the difference between the uncoated pellets, the coated pellets (no curing) and the coated pellets cured (80°C for 24h).
The first mentioned release 100% of the API in less than 20 minutes, the second release 50% of the API in less than 1h and reach 90+% in about 4h, while the third release 50% of the API in 7h and at the end of the dissolution test (12h) has released only 70% of the API.





PROCESS CONFRONTATION:

As visible on the left, the powder layering technology applied in fluid bed allows to achieve similar release profile to the more common suspension coating technique.
It just require the accurate use of polymer w.g. curing time and curing temperature.



Note: the Y Axis is in logaritmic scale

Process Parameters	Suspension Coating	Powder Layering
Airflow	140m³/h	175m³/h
Product Temperature	40°C	40°C
Atomization Pressure	2.0bar	0.5bar
Accelerator / Eductor Pressure	1.5bar	1.5bar
Pump Speed	20g/min	6g/min
Powder Rate	-	6g/min

CONCLUSIONS

- Despite being born as a mean to introduce anti-tacking agents in the process container, the Wurster Pro™ proved to be a potential powder layering/powder coating alternative to the more commonly used rotor; being able to achieve high weight gain in short time.
- In term of efficacy, the powder layering conducted in bottom spray showed to be able to replicate release profiles, achieved by suspension coating in the same system.
- Being a technology that relies on the application of solids directly on the surface of the desired cores, the curing step is mandatory and extremely important for the correct functioning of the polymer.
- Curing efficacy is heavily influenced by time and temperature applied.
- Depending on the characteristics of the API and polymer used (temperature stability, polymer's glass transition temperature, polarity, release profile desired…) different type and concentrations of plasticizer might be necessary.
- Powder layering remain an invaluable technique for applying high quantity of polymer, being capable of halving the process time (even with an unoptimized process), and its application in bottom-spray fluid beds, open new possibilities for industrialization.