**Phase III & IV – Nathan’s Scope and Unit Process**

Scope: Mixer and Capsule Filler Machine

PFD for this process section:

Mixer

Capsule Filler

Powder Flow Pump

Empty Capsules

Formulation

Dried Cells

Filled Capsules

Formulation

Excipients

**Capsule Filler:**

Our defined hourly rate of production will be 100,000 filled capsules per hour. It is nice to think of these discretely rather than as a bulk-flow. We can achieve conventional bulk-flow analysis, however, when we know the exact mass of formulation inside each capsule. The team has defined that to be 1 gram. Thus,

For the capsule filler, we have 100 kg/hr of formulation flowing into the capsule filler per hour. One can see very quickly that there will be a required 100,000 empty capsules per hour to flow to the capsule filling machine as well. Lets look at the mixer.

**Mixer:**

The mixer has two streams in and one stream out. In this unit operation, we are mixing the dried cell mass together with the excipients. In the formulation, 20% of the mass is due to the dried cells, and the other 80% comes from the excipients. The excipients are comprised of the following ingredients:

* Maltodextrin
* Inulin
* Talc
* Magnesium Stearate
* Colorants (Titanium Dioxide and Iron Oxide).

Per one capsule that contains 1 gram of formulation, the following recipe applies:

|  |  |  |
| --- | --- | --- |
| **Ingredient** | **Mass** | **Mass Fraction** |
| *Bacteria Blend* | 200 mg | 0.2 |
| *Maltodextrin* | 400 mg | 0.4 |
| *Inulin* | 200 mg | 0.2 |
| *Talc* | 50 mg | 0.05 |
| *Magnesium Stearate* | 50 mg | 0.05 |
| *Colorant* | 100 mg | 0.1 |

Note the following mass fractions in the formulation out-stream above.

We can use this to get the mass flowrates of the inlet streams: