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Title:
Improvements made for Consistency of Weight Accuracy of the Neem coated Urea Bag.

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BRIEF ABOUT IFFCO

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IFFCO is a multi-state cooperative society. IFFCO has been producing fertilizers since more than 50 years. Kalol unit is the Mother plant of IFFCO which was commissioned in the year 1974. IFFCO Celebrated golden jubilee in the year 2017

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Significance of Bagging and filling Accuracy

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- Protection of the highly hygroscopic Urea from the moisture in the environment.
- Effective logistics for safe transportation up to the final application in the fields.
- Moral and legal obligation to maintain the accuracy of the net weight per bag i.e., =/> 45.00 Kg.
- With accuracy, the losses to the industry from filling overweight can be prevented.

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Abstract

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- The most significant challenge is the accurate filling of the material in the bags at rapid bagging rate.
- **Accurate filling**: 45.05 Kg, +/- 20 grams which is +/- 0.044 % of the 45.05 Kg.
- **Average bagging rate**: 900 (+/- 50) bags per Hour with consistent manual bag placing.

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Bagging Machine specifications by the OEM

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- Equipment type: Semiautomatic Weighing & Bagging Machine.
- Operation Principle: Gravity feeding, Load cell-based weighing.

- Weighing Range : (50 Kg), now 45 Kg.
- Bagging Rate: 600 Bags/ Hour.
- Accuracy and repeatability of weight: ± 50 grams for average of 20 consecutive weighing.
- Controller : CSC 25 BMN

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Pneumatically operated Feed Gate assembly

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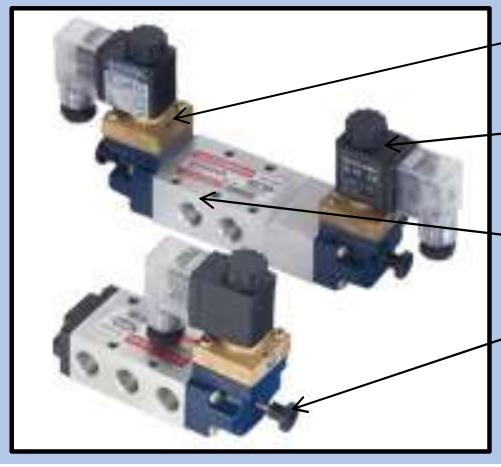
- The load cell gives analogue weight signal input to the controller. In turn the controller gives digital outputs for sequential machine operations through solenoid valves and pneumatic cylinders installed in the field.
- The Gate assembly precisely controls the flow of urea in two stages sequentially as coarse and fine feeding by means of pneumatic solenoid valves and cylinders.



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Machine Operation sequence of feeding and weighing

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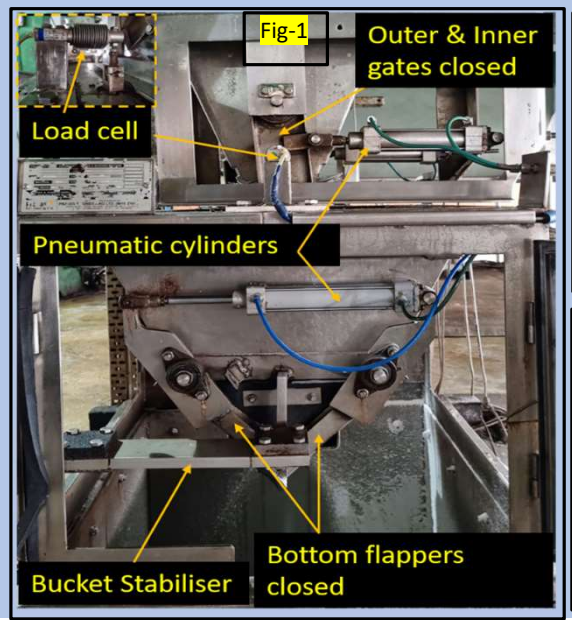
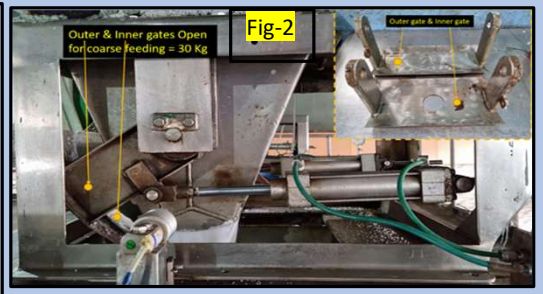
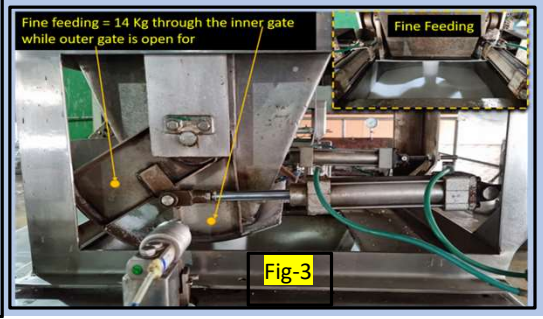
1. Machine status Before the Start command as Figure-1.
2. On giving the machine start command, if the bucket is empty and the bottom flapper is closed, then the feeding sequence starts as follows.
3. Coarse Feeding with Both Gates Open up to 30 Kg (Figure-2).
4. Fine Feeding with Inner Gate Closed up to 44 Kg (Figure-3).







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Operation sequence of feeding and weighing

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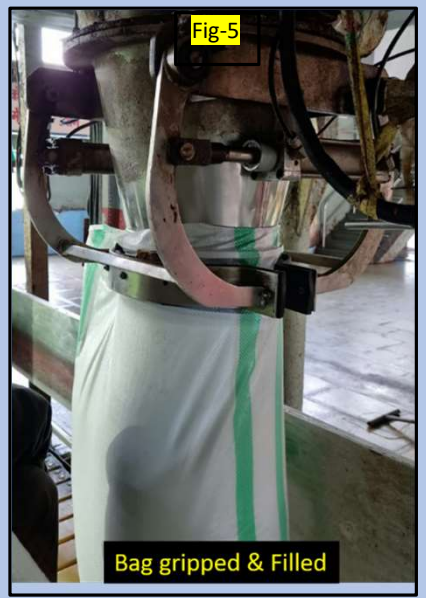
3. After closure of outer gate, the in-flight material, around 1 Kg as per the cutout area of the inner gate. Thus, the feeding stops at 45.00 Kg, the target weight. The controller gives out a signal termed as balance Full.

4. Now if the bag is placed at the bag spout, then material shall fall into the bag (Fig-4 & 5)

5. The filled bag is released (Fig-6)



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Under/ over filled weight and remedy suggested by the OEM

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- In general, there are two kinds of faults i.e. weight deviation and weight variation.
- Definition of weight deviation: The weight of the filled bags is shifted to less (Underweight) or more (Overweight) than the target weight, but the consecutive bags have the same weight.
- Remedy: Change the target weight to solve the problem. If not solved, then perform the zero calibration. If major shift is found then perform the zero and span calibration. Mostly the problem is solved.

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- Definition of Weight Variation/ or unstable weight: The weight of consecutive bags is not consistent or varying or drifting frequently.
- Remedy: Following steps were sequentially followed to solve the weight variation completely.

1) Alter the target weight and other parameters on controller
2) Perform full calibration of the bucket.
3) Check the millivolt output of both the load cells.
4) Check the Resistance of both the load cells with power supply off.
5) Check the bucket alignment and perform the alignment if found disturbed.

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6) Check the cylinder operations with manual push buttons.

7) Replace the cylinders if found jammed or operating in sluggish manner.

8) Replace the mechanical bucket stabilizers.

9) Adjust the gate opening.

10) Replace the load cell.

11) Replace the controller.

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Significant observations of Machine components and it's operations

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1) The machine operations are controlled through a programmable controller.
2) The weighing pan is suspended on two load cells having the accurate weighing capacity of 1,000 N = 101.97162 KGF each. Therefore, it can't be damaged unless hammered.
3) The mechanical stabilizers are meant for preventing drift in the weight owing to the bucket swing during or after filling of material.

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Significant observations of Machine components and it's operations

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4) The bucket alignment hardly shift after the locking nuts of bucket suspension bolts are tightened properly.

5) There is hardly any malfunction of the electronic devices as the maintenance SOP is followed properly.

6) Quick operations of the solenoid valves and pneumatic cylinders are essential to maintain the feeding accuracy.

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Paradigm Shift in the Maintenance practices from Sept. 2013:

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1) Modified rate of bagging of our individual machine is 15 to 16 bags per minute. Thus, each cycle of bagging takes 4 seconds approx. which include sequential operations i.e. (1) Coarse Feed (2) Fine feed (3) Fine feed cut off (4) Material discharge and (5) Sack release. Thus, each operation must be accomplished within 1 sec.
2) Suppose if the coarse feeding (30 Kg) takes 1.2 Sec (20 % more than the specified) owing to sluggish operation of the pneumatic components then this may cause pouring of 20 % additional material which is 6.0 Kg or total 36 Kg. Similarly, if the operation of the fine feed cylinder takes 1.2 Sec., then it will add 14 Kg plus 2.8 Kg. Thus, little sluggish operation of any pneumatic component adds very huge error in terms of few Kg.

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3) The average bagging rate of bagging plant is 4000 bags per day per machine. Thus, for each machine, the plungers of the SOVs and the pistons of the pneumatic cylinders undergo 4000 reciprocating operations.
4) Wearing out of the rubber O rings (Seal rings) occurs owing to the friction with their metallic counter parts.
5) This results into leakage of the air causing sluggish operation of the SOVs and cylinders.
6) Therefore, the operation timing accuracy of the Solenoid Valves and cylinder is affected significantly resulting into weight variation as explained in the point number 2 above. Therefore, as soon as we observe any weight variation, we replace the O ring sets of the solenoid valves and cylinders employed for material feeding.

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7) The removed SOVs and cylinders are refurbished with new seal kits (O rings). The repaired solenoid valves and cylinders are tested for perfect operation with leakage test in terms of the air bubbles in the water. It is ensured that no seal ring passes the air.
8) As a result of the above, correct, quick and effective maintenance practices, the machine performance consistency is ensured as mentioned in the following table:

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Drastic improvement in the performance

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Parameter	Specified by the OEM	Achieved by IFFCO Kalol
Rapidity, Bags / Hour in ideal conditions	600 Bags/ Hour	900 + Bags/ Hour
Weight checking frequency	After every 20 bags	After every 400 to 450 bags as we check it after every 30 minutes,
Accuracy	+/- 50 grams (Hardly maintained)	+/- 20 grams (Confirmed)
Practical bagging rate, Bags/ Hour	Not specified	@ 800 to 900 bags / hour

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Benefits owing to modified maintenance practices:

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- Underweight bag is never allowed to ensure that the minimum net weight is maintained.
- Load cell replacement frequency has been reduced to 1/10 of the earlier frequency.
- We refurbish the solenoid valves and pneumatic cylinders by replacing only the seal kit which is very cheap as compared to a full set causing great benefit.
- Owing to the faster bagging rate, railway rake is loaded in time. We need not to pay any demurrage to railways due to delayed departure of rake.

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Conclusion

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- Periodic preventive maintenance is must for any material handling system.
- The root cause analysis for each of the task or problem must be done effectively through logical thinking.
- Thinking out of the box is essential for an engineer.
- Owing to the above, the task solution becomes convenient, more effective and sustainable.

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Continuous Improvement
= Human being

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Efficient engineering can save the beauty of the environment

Thank you!