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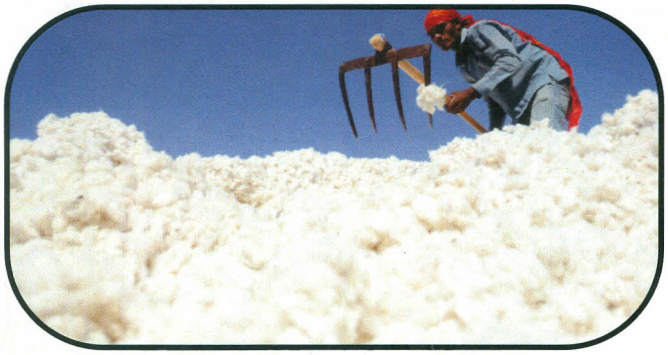
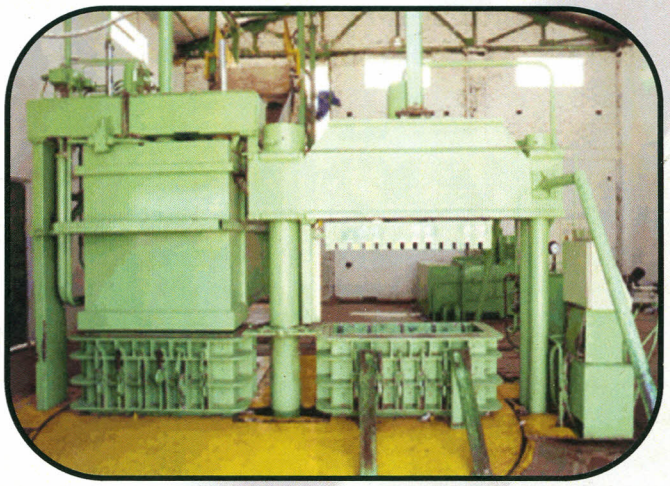
CIRCOT Study on Cotton Bale Press

(Energy Consumption and Cost Economics)



Down-Packing Bale Press



Up-Packing Bale Press

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Rationale

Bale packaging is the final step in processing of cotton at ginneries. With the continued development in manufacturing of bale press along with the modernisation of ginneries in India, the focus is now shifted from the double stage conventional presses to fully automatic presses. Cotton bale presses are either single or double box, up or down packing, revolving or fixed, door-less or with door, with mechanical or hydraulic tramper and if hydraulic, it is either oil or water based.

Both the down and up-packing type of automatic presses consist of a battery condenser, lint slide, lint feeder, tramper, bale press box, hydraulic ram and cylinder, hydraulic power pack, hydraulic fittings and an electrical control panel. In the down-packing type press both the hydraulic ram and the press box are located above the ground level and the pressing of cotton bale is carried out by the downward movement of the hydraulic ram housed inside the press box. While in up-packing type of presses, the hydraulic ram and the press box are located below the ground level and the pressing is carried out by upward movement of the hydraulic ram housed in the press box.

Automatic presses have many advantages over the existing conventional (manual) presses. An automatic press has the auto-trampling facility that reduces labour requirement and avoids contamination of lint. Increased usage of these presses in recent years has resulted in improvement of the quality of lint besides, ensuring safety of the workers by eliminating the drudgery involved in the operation of a manual bale press.

Presently, more than 1000 automatic baling presses are in use in the Indian ginning industry, the capacity of bale presses varies from 8 to 35 bales/h. The selection of the appropriate bale press has become a difficult task for the ginners due to variation in design, make, model, capacity and techno-economic feasibility. Operating cost is largely affected by the total power requirement and energy consumption per bale. The power requirement and energy consumption are influenced by the time required for each unit operations such as pressing, tramping, box movement, tying, turning and cooling.

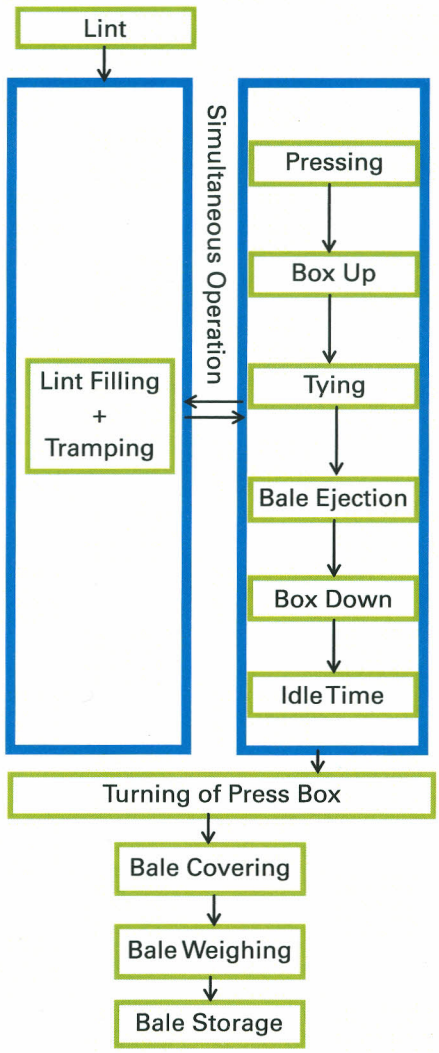
Normally, ginners are unaware of the techno-economic constraints as well as the advantages of the different makes and models of presses. Selection of appropriate automatic up and down packing type of bale press should be done based on the techno-economics with special emphasis on energy consumption per bale. Ginners need to pay attention to practices that can save energy and money, and ensure at the same time to improve energy efficiency and safety of workers. As it is unlikely the price of energy to go down, we need to find ways and means to reduce the quantum of energy used in cotton ginning and pressing.

Methodology

The fully automatic down and up-packing type bale presses were selected for the experimentation. Experimental trials were carried out during the year 2011-12 and 2012-13 in commercial ginneries that were modernised as per norms of Technology Mission on Cotton Mini Mission- IV (TMC MM-IV) of Government of India. Three models of automatic down- packing type bale press viz. BP1, BP2 and BP3 with capacity of 15, 25 and 8 bales/h respectively were studied. Four models of automatic up-packing type bale press viz., BP4, BP5, BP6 and BP7 with capacity of 12, 15, 15 and 25 bales/h respectively were studied. The characteristic features of these presses were noted.

Different unit operations involved in cotton bale pressing were studied. The power requirement and energy consumption for different unit operations was measured. The time motion study of each unit

operation was carried out.The Clamp on Power Meter (CW240) manufactured byYokogawa, Japan was used for measurement of energy consumption.The data was collected on power required, energy consumption, current, voltage, and power factor for each unit operation.The comparative analysis of energy consumption was carried out and interventions were suggested to improve the energy efficiency.



Flow Chart of Baling Operation Cycle

Power and Energy Consumption

A bale press has different components and each of them performs a specific unit operation.The major unit operations in bale packing are pressing, tramping, tying, cooling, turning etc.These unit operations are performed either by separate electric motors or in combination.The power requirement and energy consumption for bale presses with capacity 8, 15 and 25 bales/h, for each unit operation of down & up-packing presses are shown in theTable 1 and 2, andTable 3 shows the comparative analysis. Energy consumption was found to be 2.25, 1.75 and 1.5 units/bale respectively for down-packing presses with capacity of 8, 15 and 25 bales/h. Energy consumption was found to be 1.0 and 0.9 units/bale respectively for up-packing presses with capacity of 15 and 25 bales/h.

Table 1: Down-Packing Bale Press: Power and Energy Consumption

Press	Capacity (bales/h)	Power (HP) & Energy Consumption (kwh/bale)							
		Pressing		Tramping		Other		Total	
		HP	kwh/bale	HP	kwh/bale	HP	kwh/bale	HP	kwh/bale
BP1	15	50	1.10	20	0.45	5	0.20	75	1.75
BP2	25	75	1.00	30	0.30	14	0.20	119	1.50
BP3	8	40*	0.85	40*	1.20	7	0.20	47	2.25

*Same Motor is used for Pressing and Tramping Operation

Table 2: Up-Packing Bale Press: Power and Energy Consumption

Press	Capacity (bales/h)	Power (HP) & Energy Consumption (kwh/bale)							
		Pressing		Tramping		Other		Total	
		HP	kwh/bale	HP	kwh/bale	HP	kwh/bale	HP	kwh/bale
BP4	12	40	0.85	15	0.25	2	0.10	57	1.20
BP5	15	40	0.47	15	0.35	3	0.13	58	0.95
BP6	15	50	0.62	15	0.25	6	0.15	71	1.02
BP7	25	60	0.62	15	0.25	5	0.15	80	0.90

Table 3: Comparative Analysis of Capacity, Power and Energy Consumption

Press	Capacity (bale/h)	Power (HP)	Energy (kwh/bale)
BP1	15	75	1.75
BP2	25	119	1.50
BP3	8	47	2.25
BP4	12	57	1.20
BP5	15	58	0.95
BP6	15	71	1.02
BP7	25	80	0.90

Cost Economics

The fixed cost is worked out both for the pressing machine and the press building. The operating cost in bale press includes charges for bale cloth, strapping, electricity, maintenance, labour and operator. The cost of operation per bale was found to be Rs.246, Rs.194 and Rs.170 for the down-packing presses with capacity of 8, 15 and 25 bales/h respectively. In case of up-packing the cost of operation per bale was found to be Rs.174 and Rs.157 with capacity of 15 and 25 bales/h respectively.

Table 4: Cost Economics of Down-Packing Bale Presses

Particulars	8 bales/h	15 bales/h	25 bales/h
Fixed cost per bale (Rs)	79	58	47
Operational cost per bale (Rs)	167	136	123
Total cost per bale (Rs)	246	194	170
Bales processed per year (Nos.)	10000	20000	30000
Initial cost of bale press (Rs in Lakhs)	40	60	75
Number of working days/year	150	150	150
Number of working hours per day	16	16	16
Capacity utilisation (%)	50	50	50

Table 5: Cost Economics of Up-Packing Bale Presses

Particulars	15 bales/h	25 bales/h
Fixed cost per bale (Rs)	44	38
Operational cost per bale (Rs)	130	119
Total cost per bale (Rs)	174	157
Bales processed per year (Nos.)	20000	30000
Initial cost of bale press (Rs in Lakhs)	45	60
Number of working days/year	150	150
Number of working hours per day	16	16
Capacity utilisation (%)	50	50

Comparative Analysis of Energy Consumption and Cost Economics

The comparative analysis indicates higher energy consumption and cost of operation for the down-packing type of presses as compared to the up-packing types for all the capacities studied. An increase in both the energy consumption and the cost of operation was noticed with decrease in the capacity of the bale press. Higher costs were observed for bale presses processing smaller volume. About 40 percent less energy is required for the up-packing presses compared to the down-packing presses. About 15 percent reduction in energy consumption was observed for bale presses with capacity of 25 bales/h as compared to 15 bales/h for both the type of presses. Up-packing type of the presses were found to be more cost effective by about 10 percent as comapred to the down-packing type of presses.

Table 6: Comparative Analysis of Bale Presses

Down-Packing			
Capacity (bales/h)	15	25	8
Power (HP)	75	119	50
Energy consumption (Units/bale)	1.75	1.5	2.25
Cost of operation (Rs/bale)	194	170	246
Up-Packing			
Capacity (bales/h)	15	25	8
Power (HP)	58	80	Data Not
Energy consumption (Units/bale)	1.0	0.9	Available
Cost of operation (Rs/bale)	174	157	

Measures for Improving Energy Efficiency of Bale Presses

Energy efficiency means the utilisation of energy in the most cost effective manner to carry out a process whereby energy waste is minimized and the overall consumption is reduced. Energy efficient practices needs to be adopted while running a bale press. After a pressing plant is constructed, efficiencies in the utilisation of energy will be determined largely by management practices.The energy use pattern in the bale press affects the economics of a ginning factory, and consequently, the ginners should be concerned about how to use energy more efficiently.The inefficient use of energy generally implies incurring higher than the necessary operating cost. Higher energy efficiency in a ginnery will reduce the operating costs and improve its profitability.

Power: The power requirement can be minimized when the bale press is designed by careful selection of component and sizes, and rightful combinations of unit operations. After the installation of baling

press in ginneries nothing much could be done to change or modify its design to improve the energy efficiency.

Uniform Feeding: Normally bale presses installed in a ginnery are of over-capacity with respect to the actual ginned lint output. Even if the ginning and pressing capacity matches, any non-uniform feeding of lint prevents the press to operate at its designed capacity. It results in decreased production and increased operating cost due to increase in energy consumption. Hence, uniform feeding of lint as per the recommendation of manufacturer needs to be ensured.

Idle time: Idle time is the time lag between turnings of the press box till the start of pressing of next bale. The idle time has a direct impact on the pressing capacity, as during the idle time, the hydraulic ram motor remains in operation. Idle time accounts for 20 - 30% of the operating cycle for the different presses.The idle time is seen because of non-uniform feeding to the press box. For improving the energy efficiency of bale presses the idle time needs to be avoided or minimized. Reduction in idle time will increase the pressing capacity, thus reducing the energy consumption per bale.

Tying: Tying time is the actual time required for strapping the bale. It has the significant effect on bale press capacity and its energy consumption. For improving the energy efficiency, the tying time needs to be kept minimum, as during tying operation the ram motor remains in operation and consumes energy. A double trigger gun can be used for the strapping operation.The use of automatic tying machines can reduce the tying time.

Tramping Operation: Tramper operates through-out the baling cycle except during the turning of press box.To have minimum energy consumption, tramping operation should be finished before the pressed bale is ejected out.The number of tramping strokes per bale should be optimized according to the pressing capacity.

Hydraulic Ram Operation: Hydraulic ram motor run throughout the operating cycle in case of down-packing type of bale press. It remains under-loaded for about 50% of operating cycle resulting in poor power factor.The energy efficiency of down packing press can be improved by minimizing the time of operating cycle during which the ram motor remains under-loaded. A suitable mechanism for stopping the hydraulic ram motor at no load condition will improve the power factor and the energy efficiency.

Power Factor: High power factor has a direct benefit in energy saving. A power factor reading below a range increases the cost per kilowatt-hour used for the machine operation. It is advisable to keep the total connected load as close to the actual load requirement as practicable for the efficient operation.The key to reducing your energy use per bale is to keep the press always fully loaded.

Energy Losses: Major losses occur from the use of old and inefficient technologies or outdated processes. Avoidable losses are the losses resulting from sub-optimal or poor design, maintenance and poor management of the press.The unavoidable losses that occur due to in-built technical reasons like the faulty design or process, could be kept at minimum by redesigning of the machine or the process.

Energy Management: Energy management should be a part of the management systems. Energy management requires knowledge and skill. Lack of technical capacity to identify, evaluate and implement the energy efficiency actions are often observed in ginneries. Ginneries often claim to have no staff resources to undertake energy management tasks. However, it may be possible to cover some aspects of energy management by using part-time staff or by using services of the research institutes like CIRCOT.

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(Disclaimer: Pictures/photographs used in this leaflet are not for promoting any particular type of bale press. The data is presented as guidelines for facilitating the cotton ginners about the cotton bale press.)