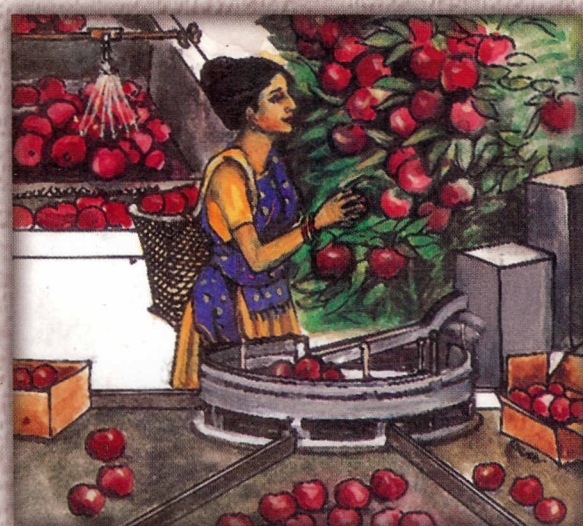




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Postharvest Management in Agriculture

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A S Chandel and R M Kamal



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POSTHARVEST EQUIPMENTS

- 1 ADHIKARINAYAKE, TB. 1990. Development of an abrasive disk dehuller for pulse grains. *RPRDC Publication*, Jayanthi Mawatha, Anuradhapura, Sri Lanka.
- 2 ADHIKARINAYAKE, TB. 1994. Foot operated coconut dehusker. National Engineering Research and Development Centre (NERD), Sri Lanka.
- 3 ADHIKARINAYAKE, TB. 1985. Hand operated rice destoner for domestic use. *RPRDC Publication*, Jayanthi Mawatha, Anuradhapura, Sri Lanka.
- 4 ADHIKARINAYAKE, TB; NAVARATHNE, SB. 1984. Performance of rice processing machinery for cleaning sesame. *RPRDC Publication*, Jayanthi Mawatha, Anuradhapura, Sri Lanka.
- 5 ADHIKARINAYAKE, TB; PALIPANE, KB; GUNATHILLAKE, KAG. 1988. Shelling performance of the rubber roll sheller and disc sheller with Sri Lankan paddy varieties in raw and parboiled form. *Tropical Post Harvest Technology -Sri Lankan Journal of Post Harvest Technology*, 1: 1, 39-46.
- 6 AHMED, M; MALLICK, MM; KARIM, KMA. 1991. Development of yarn pulling through and bobbin rewinding system to control the yarn vibration in the measurement of PMD by new napier mean deviation meter. *Bangladesh Journal of Jute and Fibre Research*, 16: 1, 2, 31-38.
- 7 ALAM, AA. 1988. Process equipment manufacture. *Indian Dairyman*, 40: 5, 285-290; 12 ref.
Dairy equipment manufacturing is a relatively new industry in India and does not as yet include the manufacture of some of the more sophisticated equipment such as UHT plant, butter moulding and wrapping machines, homogenizers or certain separators and packaging machines. The main technical and economic requirements of the dairy equipment manufacturing industry in India are outlined and the following development projects are discussed: equipment for *khoa* making (continuous *khoa*-making machine, mechanized pan for rural applications, conical process vat, scraped-surface heat-exchanger, membrane process); equipment for *gulabjammun* production; *ghee*-making equipment; production of *chhana/paneer*; *shrikhand*-making equipment. There are currently > 130 dairy equipment manufacturers in India, including 5 large public sector establishments.
- 8 ALI, KA; BALASUBRAMANIAN, M. 1989. A new tool to determine resistance in stored grains to weevils. *Madras Agricultural Journal*, 76: 4, 239-240; 4 ref.
A plastic tray that can be used to give test organisms a free choice of different samples of stored grain is described. The apparatus was used to investigate the resistance of grain from sorghum varieties to attack by *Sitophilus oryzae*. The resistance of the varieties was as follows: IS 7173 = IS 3443 > IS 3606 = IS 3569 > IS 8789 > PJ 32 K.
- 9 ALI, Y; MATHUR, AN; SHARMA, D. 1989. Development of a drier for perishable products for on-farm and community level drying. *Renewable energy for rural development. Proceedings of the national solar energy convention*. (Hyderabad, India: 1988: 1-3 December)/edited by VVN Kishore; NK Bansal. New Delhi: Tata McGraw-Hill, p.400-404; 4 ref.
A tray drier was designed and fabricated with a special feature so that it could be used for both direct and indirect drying. Provision was made for achieving desired variation in drying for the products in a particular group. The drier was tested and the maximum temp. attained was 60-65°C in direct conditions and about 60°C in indirect conditions. Six trays of 1.1 m length, 0.6 m width made of aluminium angle and wire mesh are used in the drier which has 2 chimneys of 1 m height and 20 cm diam. with solar aspirators. Full load testing and effect of air inlet opening on drier temp., air flow rate and verification of drying time for cauliflower, pumpkin and tomatoes are presented.
- 10 ANANTHACHAR, M; MAURYA, NL; GURUSWAMY, T. 1992. Pedal power for groundnut decortication - a case study. *Karnataka Journal of Agricultural Sciences (India)*, 5: 1, 76-79.
- 11 ANNAMALAI, SJK; NARAYANASWAMY, KG; PATIL, RT. 1989. Design and development of a natural convection type low cost dryer for medium holdings. *Journal of Plantation Crops*, 16: Supplement, 81-90; 5 ref.
A simple and cheaper drier working on indirect heating and natural convection principles using dry agricultural waste as fuel was designed and developed to suit medium sized plantation crop holdings and processing units. It consists of a drying chamber, burning cum heat exchanging unit and chimney and can hold 1000-1200 coconuts or 375 kg of ripe arecanuts per batch. The

drying time required is about 33-37 h for copra and about 87 h for arecanut. As a preliminary study, the drier was tested on 75 kg green cardamom in trays but slight discolouration of the product was observed after drying. The thermal efficiency of the drier was 18.7-23.4%. It costs about Rs. 4000 and requires an area of 7 m² for housing. Economic analysis has shown that this drier can be profitably used during monsoon months.

12 ASIAN INSTITUTE OF TECHNOLOGY, BANGKOK, THAILAND. 1990. Agribusiness potential in agricultural machinery manufacturing. *Proc. of the International Agricultural Engineering Conf. and Exhibition.* (1990: 3-6 Dec)/ edited by VM Salokhe and SG Ilangantilebe. p. 405-414; 5 ref.

The use of agricultural machinery will continue to rise in developing countries as farm labour and draught animals become more expensive and scarce. Farmers will eventually mechanize to reduce production costs. In the RNAM participating countries (Bangladesh, India, Indonesia, Iran, Nepal, Pakistan, China, Philippines, Korea, Sri Lanka and Thailand) farmers have expressed a substantial demand for improved and power-operated machinery which involve tractors and power tillers; pumps for irrigation; sprayers for crop protection; equipment for crop drying; handling and storage; and harvesting and processing equipment. There is therefore great potential for agricultural machinery manufacture in these countries.

13 ASIAN PRODUCTIVITY ORGANIZATION, TOKYO, JAPAN. 1989. Food processing equipment in Asia and the Pacific. *Proceedings of the Seminar on Food Processing Equipments.* (China: 1986: 14-19 April). 288p.

The first 8 chapters give details of papers presented at a seminar on Food Processing Equipment, organized by the Asian Productivity Organization, held in China on 14-19 April 1986, covering - Japanese food industry in perspective; development of food processing equipment for small-and medium-sized food industries-Taiwan's experience; sanitation design and operation of food processing equipment; pre-treatment of raw materials; application of extruders in the food industry; Japanese food industry activities in the development and use of twin-screw extruders; application of microprocessors in the food industry; and modern and traditional food processing equipment. Food processing and equipment used in other APO countries (China, Fiji, Hong Kong, India, Malaysia, Philippines, Singapore and Thailand) are also described.

14 AWADHWAL, NK; YULE, DF. 1991. New implements for small farmers of the semi-arid tropics. *World Animal Review*, 68: 3, 73-77; 8 ref.

A range of implements developed for farmers in the semi-arid tropics is described. They include: Agribar II, used for various tillage operations and which can be fitted with a four-row planter, and simple T-bar bullock-drawn implements for making broadbeds, applying fertilizer, sowing and interrow cultivation; three different models of crust-breaker, covering one row, two rows and a metre-wide strip, to enhance the emergence of seedlings through the soil crust; a twin spinning-disc knapsack-sprayer for low-growing crops; a groundnut digger for hard soil, with chisel points to assist penetration; and a donkey-drawn cultivator-cum-seeder for sowing pearl millet and sorghum in hills and for inter-row weeding on light-textured soils.

15 AWAKNAVAR, JS; KRISHNAMURTHY, KC; BABU, CK; RAMAKUMAR, MV. 1989. Different storage structures for safe storage of pulses. *Mysore Jrl. of Agril. Sciences*, 23: 4, 526-532.

Five storage structures that could be used at farm level were tested for storage of pulses (especially red gram (pigeon pea)) against the bruchid *Callosobruchus chinensis*. The performance of non-permeable structures such as metal bins and coal tar drums was better than other structures so far as deterioration, germination and weight loss were concerned. Percentage weight losses were 3.2, 4.2, 4.8, 6.3 and 5.0, for metal bin, coal tar drum, gunny bag, plywood bin and earthen pot storage, respectively. However, there was not much difference in moisture migration and temperature gradient among different structures during storage.

16 AXTELL, B; BUSH, A. 1991. Try drying it! Case studies in the dissemination of tray drying technology. London: Intermediate Technology Publications, 63 p.

The development of a small scale industrial tray drying system for use in developing countries is described. Case studies are presented of its use in Guatemala, Peru, Colombia and Bangladesh for the drying of herbs, including parsley, camomile, lemon verbena, lemon balm and lemon grass, coconuts and other fruits and vegetables. Information is provided on costs and benefits and the economics of small scale drying. A final section considers factors which need to be taken into account when selecting drying systems and types of driers for small industries in developing countries. An appendix provides general information on drying theory.

17 BABU, N. 1990. **Improved version of Lotus roller - the couch rollers - for improving primary extraction.** *Thirty-eighth Annual Convention 1988: Deccan Sugar Technologists' Association (India)*. Pune: DSTA, Part 1, E17-E22; discussion in Part 2, SE4-SE5.

The couch roller was designed primarily to be used as the top roller in any 3-roller mill; it is also advantageous as the discharge roller of the last mill. As with the Lotus roller, the steel shell has radial perforations leading to axial channels in its body; the distinction of the couch roller is that vacuum is applied to the lower part of the sides, assisting drainage of juice from the axial channels and thus enhancing the advantages of the Lotus roller. Since flooding is eliminated and the cane layer is drier, the rollers give stronger grip and thus better feeding; since there is less slippage, there is less wear; the rapid escape of juice practically eliminates reabsorption and gives quicker decrease of material throughput. This decrease and the lack of slippage decrease the power consumption; for a given power consumption, cane throughput can be higher by up to 15% than in a conventional mill of similar size. The better recovery of juice leads to higher sucrose extraction. Data on pol and moisture in bagasse from the 1st mill throughout the 1986-87 and 1987-88 seasons are tabulated; it is noted that each 1% decrease in bagasse moisture should increase the overall Reduced Mill Extraction by $\approx 0.2\%$

18 BALA, BK; WOODS, JL. 1993. **Simulation and optimization of natural convection solar drier.** *Proc. of Solar 93 Conference*. Washington, D.C.

19 BALA, BK; WOODS, JL. 1994. **Simulation of the performance of polythene and glass covered natural convection solar driers a comparison.** *Proceedings of the World Renewable Energy Congress Held at Reading*. 1994: 11-16 Sep. U.K.

20 BANDYOPADHYAY, S. 1990. **Techno-economic studies of fish-drying in plastic-covered solar-dryers.** *Energy and the environment into the 90s: Proceedings of the 1st World Renewable Energy Congress*. (Reading: 1990: 23-28 Sep.)/edited by AAM Sayigh. Oxford: Pergamon, p. 898-903; 6ref.

Performance of a greenhouse type solar fish-drier was tested with clear polyethylene (LDP) and acrylic (PMMA) sheets as covers. The prototype small-scale drier with a capacity of about 56 kg fish per batch was scaled down for a comparative study of fish drying. The temp. rise over ambient temp. inside the drier was higher by 2-7°C in the PMMA-covered drier, and fish m.c. could

be reduced by about 4.5% more than that in the LDP-covered drier within 2-3 days. However, economic analysis in terms of unit cost of production showed that solar drying was costlier by 22-26% in the PMMA-covered drier for a similar batch operation. Easy availability and low cost of LDP sheets and lower cost of production may make the LDP-covered solar drier economically more attractive to the fish processing community.

21 BHAD, SB. 1990. **Modern milling equipments.** *Thirty-eighth Annual Convention 1988: Deccan Sugar Technologists' Association (India)*. Pune: DSTA, Part 1, E53-E59; discussion in Part 2, SE10-SE12.

High crushing rate and high mill extraction require suitable cane preparation and cane feeding. Features of the design and operation of the fiberizer used for cane preparation are listed, and a survey is given of various cane feeders and desirable features of their design. Diagrams are included of: a 2-roller pressure feeder, which is mounted on its own frame; a short-space 2-roller pressure feeder, which is installed on the mill cheek and can therefore be accommodated in the existing space between 2 mills without shifting either mill.

22 BHADANIA, AG; SHAH, US. 1989. **Drying of industrial casein - a review.** *Indian Dairyman*, 41: 11, 566-569; 28 ref.

The behaviour of casein during drying, methods used for drying of industrial casein, namely sun-drying (commonly used by small private firms in India) and drying in tray driers, fluidized bed and other types of industrial driers, energy requirements for drying, and research aimed at improving casein drying techniques are reviewed.

23 BHARDWAJ, PK; SRIVASTAVA, DN; BENIWAL, BS. 1988. **Enhancing the keeping quality of raw milk cooled in LDP packets.** *Asian Journal of Dairy Research*, 7: 2, 59-65; 9 ref.

Raw milk from the University farm was packaged in heat-sealed 0.5-litre food-grade low-density polyethylene packets and cooled in ice-cold water to 5 or 15°C, then stored in an insulated container (IC) or covered plastic bucket (PB), with or without addition of ice after 1 and 8 h. Standard plate count (SPC) increased significantly ($P < 0.05$) within 4 h in milk cooled to either temp. and stored in PB without addition of ice, and within 8 h ($P < 0.05$) in all samples except those stored in IC with addition of ice. Samples stored in either IC or PB without addition of ice were rejected after 16 h. Sam-

ples stored in IC with addition of ice had a keeping quality of > 16 h on the basis of SPC, coliform count, methylene blue reduction time and clot-on-boiling test result when cooled to either temp., and acidity increased from 0.159% initially to 0.175 and 0.187% at 16 h in samples cooled to 5 and 15°C respectively

24 BUTANI, KM; SINGH, G. 1994. Decision support system for the selection of agricultural machinery with a case study in India. *Computers and Electronics in Agriculture (Netherlands)*, 10: 2, 91-104.

25 BUTT, KM. 1991. Development and manufacture of the whole crop harvester in Pakistan. *RNAM Newsletter*, No. 41, 10-11.

The development of a whole crop harvester is discussed with some information on the work carried out to reduce cleaning losses and grain damage. The final design of the harvester and its mode of operation are outlined.

26 CHAKRAVERTY, A; MORE, HG. 1983. Development and testing of a simple baffle type grain dryer. *Agricultural Mechanization in Asia, Africa and Latin America*, 14: 4, 41-44.

A simple baffle type grain drier of 100 kg holding capacity has been developed and tested with both raw and parboiled paddy. The average heating efficiencies, i.e. heat utilization factor and total heat efficiency were 0.84 and 0.72 respectively. The head yields obtained from the raw and parboiled paddy dried continuously in the baffle drier corresponding to 60 and 70°C air temperatures were 46 and 67.5%, respectively. The head yields of the control raw and paddy samples were 52.8 and 72.8%, respectively. The drying performance of the drier was found to be good.

27 CHATTOPADHYAY, PS; JAI SINGH. 1990. Development and evaluation of rotary disc mower for harvesting of forage crops. *Agricultural Engineering Today*, 14: 1-2, 32-40; 6 ref.

A tractor operated rotary disc mower was designed, developed and tested for harvesting of berseem, lucerne and oats. The effective field capacity of the machine was 0.35 ha/h with 74.4% field efficiency. The cost of harvesting berseem with the machine, including gathering, was reduced to Rs.160/ha which is about 50% of the cost of manual harvesting by sickle. There were no adverse effects on regeneration of multicut variety forage crops due to machine traffic and impact cutting. The machines were very efficient and economical in level fields.

28 CHOUDHURY, C; GARG, HP. 1993. Performance of air-heating collectors with packed airflow passage. *Solar energy (USA)*, 50: 3, 205-221.

29 DATT, P; ANNALMALAI, SJK. 1991. Design and development of straight through peg tooth type thresher for paddy. *Agricultural Mechanization in Asia, Africa and Latin America*, 22: 4, 47-50; 5 ref.

A peg-tooth type thresher was designed and developed for use by paddy farmers in all regions of India. It has a threshing efficiency of 99.98%, output of 640 kg/h, cleaning efficiency of 98.0%, low power requirement (6 hp) and is low cost (\$765). The straw comes out of the thresher almost full length, as required by the farmers. The design details and performance data are discussed.

30 DHINGRA, HS; WADHWA, DS; BHATTI, MS. 1992. Microcomputer based instrumentation of thresher's spike. *Int. Conference on Agriculture Engineering. AgEng '92*. (Uppsala (Sweden): 12th: 1992: 1-4 Jun). Jordbrukstekniska Inst. p. 414.

31 DISSANAYAKE, LALITHA. 1992. Development of the state machinery for women in Sri Lanka. *Status of Women (Sri Lanka)*, p. 114-116.

32 DIXIT, DK. 1992. Techno-economic evaluation of the potential for solar cold storages in India. *Proceedings of the Annual Conference, American Solar Energy Society, Inc (USA)*, 209-211.

33 DURAIRAJ, CD; JESUDAS, DM; KARUNANITHI, R; SWAMINATHAN, KR. 1991. A portable field recording device for draft measurement. *Agricultural Mechanization in Asia, Africa and Latin America*, 22: 4, 65-68; 3 ref.

A very simple, fairly accurate and portable load measuring/recording kit was developed for use by researchers on farm implements in developing countries. The unit involves a 2 stage strain amplifier and an audio recorder converted to a field recorder with a simple timer-based frequency modulator to record analogue load signals to the audio tape and filter based FM demodulator to play back the recorded analogue output. A programme for an 8085 microprocessor was developed to digitalize the recorded data and to compute the av. load signal at 100 m-sec intervals. The unit pull was tested and compared with a non-recording pull type dynamometer and gave a precise reading of the plough tested.

34 EUSUFZAI, SUK; HOSSAIN, SMI; HOSSAIN, MA. 1993. Design and fabrication of a sugarcane

bud chip cutting machine. *Bangladesh Journal of Sugarcane*, v. 12-15: 115-117.

35 FERNANDO, AMA. 1989. **A mulch roller for the management of cover-crops.** *Coconut Bulletin (Sri Lanka)*, 6: 1, 11-13.

36 GARG, HP; SHARMA, S. 1990. **Mathematical modelling and experimental evaluation of a natural convection solar drier.** *Energy and the environment into the 90s: Proceedings of the 1st World Renewable Energy Congress.* (Reading: 1990: 23-28 September)/edited by AAM Sayigh. Oxford: Pergamon, p. 904-908; 7 ref.

The analytical model is helpful in predicting the hourly variation of drying air temp. and m.c. of the product under thin layer drying conditions. These are based on the simultaneous heat and mass transfer at the product surface and include the effect of humidity. The model is numerically simulated to evaluate its performance and results obtained are compared with the experimental observations carried out with a prototype model.

37 GARG, HP. 1990. **Status and prospects of solar crop drying.** *Energy and the environment into the 90s: Proceedings of the 1st world renewable energy congress.* (Reading: 1990: 23-28 Sep)/edited by AAM Sayigh. Oxford: Pergamon, p. 618-632; 11 ref.

An estimate of post harvest losses especially in developing countries, technology of solar drying and economics of solar drying are discussed. Design details of some popular and most studied solar driers are also discussed briefly. These include rack types, solar cabinets or boxes, greenhouse types, chimney types, solar timber driers, bin grain driers, tunnel or belt driers.

38 GARG, IK; MADAN, AK; SANTOKH SINGH. 1990. **Performance evaluation of tractor-operated groundnut diggers.** *Journal of Research of Punjab Agricultural University*, 27: 4, 645-651; 2 ref.

A groundnut digger shaker windrower and groundnut digger with corrugated roller were evaluated and the economics of mechanical harvesting were compared with manual harvesting. The output of the groundnut digger shaker was 0.22 ha/h while operating at 2.5 km/h with 85.5% pod recovery compared with 0.38 ha/h with the corrugated roller type digger, the operating speed of which was higher (2.75 km/h) with higher pod recovery of 91.9%. Plants remaining undug were nil in both cases. Total labour requirement in the case of the groundnut digger windrower was almost half, (30 man-h/ha) of that of the digger with corrugated roller

(59 man-h/ha) while it was 150 man-h/ha for manual harvesting. No appreciable difference in cost of digging (Rs 246-262/ha) was observed between the two types of mechanized digging while it was Rs 375/ha for manual harvesting.

39 GUJARKAR, K.G. 1988. **Design, development and testing of controlled humidity dehydrator for some fruits and vegetables (M. Tech.).** Punjabrao Krishi Vidyapeeth, Akola. 107 Pages.

A system was developed for dehydration of vegetable in the laboratory. In this system, humidity, temperature and air flow rate were controlled. The study was conducted on spinach. Hot water spray and hot air were mixed in humidifying chamber and further dehumidified in secondary heating unit. The control of desired temperature and humidity finally required was kept in plenum chamber. The control of temperature and humidity operations was automatic through double throw relay connections. The auto recording and graph printing mechanism was developed to take continuous recording on graph. Exact control of RH and temperature was found difficult in test environment. There were some variations. Auto recording and graph printing mechanism was necessary in continuous drying system of vegetable. Drying rate decreased variably with increase in relative humidity. Time taken to reach equilibrium moisture content also depended on the humidity. At 50°C and 70% RH the time required to reach EMC was 360 min, whereas at 50°C and 50% RH it was 315 min. Therefore, higher humidity prolonged the time to reach EMC. The per cent moisture content increased with increase in humidity and decreased with increase in corresponding temperature. Rate of drying during the constant period increased at lower humidity. Drying constant varied with moisture content. The values of c and n (Henderson's equation) were found independent with humidity. Rehydration ratio increased with lower humidity. Coefficient of rehydration increased at higher humidity. The retention of ascorbic acid was more at higher humidity.

40 GUPTA, D; SOLANKI, SC; SAINI, JS. 1993. **Heat and fluid flow in rectangular solar air heater ducts having transverse rib roughness on absorber plates.** *Solar energy (USA)*, 51: 1, 31-37.

41 GUPTA, RA; PARMAR, MT. 1991. **An improved blade for groundnut digger.** *Groundnut-News*, 3: 1, 7.

A new groundnut harvester blade was developed and tested. It has a number of advantages: it cuts deeper leaving a min. number of pods in the soil and reducing

harvesting losses by approx. 47%; it reduces time requirements for harvesting; it has a simple design and is not expensive.

42 GUPTA, RK; Bhole, NG. 1991. Efficiency of a compartment-type rice separator. *International Rice Research Newsletter*, 16: 5, 28-29.

The effect of stroke length and table slope on the quality of separation, capacity and energy consumption of a compartment - type rice separator was investigated. It was found that separation was most effective with a 1-2° slope and a stroke length of 150-165 mm, that capacity increased with table slope and stroke length, and that energy consumption decreased as table slope increased and increased as stroke length increased.

43 GUPTA, SK; AGRAWALA, SP; PATEL, AA; SAWHNEY, AK. 1987. Development of equipments for indigenous dairy products. *Indian Dairyman*, 39: 9, 419-425; 14 ref.

Mechanization of the manufacture of indigenous Indian milk products is discussed. Equipment for *khoa* manufacture, developed at the National Dairy Research Institute, comprises a steam-jacketed stainless steel conical vat with rotary scrapers, agitation baffles and a propeller for efficient discharge of the product. A continuous process (the RMA process), has recently been developed which uses reverse osmosis to concentrate skim milk prior to *khoa* manufacture. The National Dairy Development Board has adapted dough mixing and ball-forming machinery conventionally used in baking, for *gulabjamun* manufacture. An industrial process for *ghee* manufacture comprises a steam-jacketed butter melting vat, a boiling kettle, storage tank and packaging unit. *Chhana* can be made by heating milk in a tubular heat exchanger followed by blending with acid coagulant, circulating through holding coils then draining whey through a mechanical strainer. Continuous *shrikhand* manufacture has been achieved using large-scale adapted curd separators.

44 HANNOTEAX, J. 1989. Packaging of dairy products - emerging scenario. *Seminar on packaging of dairy products synchronising with Indiapack '89 and Ahara '89 Exhibition*. (New Delhi: 1989: 1-2 February). Bombay: Indian Institute of Packaging, p. 1-12.

The ERCA group's form-fill-seal and other packaging systems are described, with technical specifications.

45 HANSEN, R. 1986. Packo - a Belgian factory specialised in fabricating stainless equipment for milk producers, dairies and food processing plants. *North*

European Dairy Journal, 52: 5, 163-168.

Equipment manufactured by Packo NV (Zedelgem, Belgium) includes on-farm milk cooling tanks, milk collection stations, pasteurizers, milk processing lines, freezers and 'mini dairies'. A 'mini dairy' is to be built by Packo NV in Pakistan, with a daily capacity of up to 50 000 litres of milk. It will produce cream, butter and UHT milk.

46 HOSSAIN, SMI; EUSUFZAI, SUK; HOSSAIN, MA. 1993. Design and fabrication of power operated sugarcane sett cutting machine. *Bangladesh Journal of Sugarcane*, v. 12-15: 13-18.

47 JADHAV, RV; DESHPANDE, JS. 1990. Development and performance evaluation of pedal-operated sunflower thresher. *Agricultural Mechanization in Asia, Africa and Latin America*, 21: 3, 29-32; 6 ref.

The 'Phule' sunflower thresher was designed as a hold-on, pedal-operated, light weight, and low-cost machine. The threshing efficiency and cleaning efficiency are 100 and 96-98%, respectively. The output capacity of the machine is about 40 kg/h. The threshing cost is Rs. 13 per quintal as against Rs. 30 to 35 per quintal for other local methods.

48 JASRAI, YT; MEHTA, AR; BHATT, PN. 1993. Protocol for fabrication of inexpensive vertical slab gel apparatus and gel dryer. *National Academy Science Letters - India*, 16: 7-8, 201-206.

49 JASWANT SINGH; BARGALE, PC. 1990. Groundnut oil expression through Rosedown mini-40 screw press (oil expeller). *Proceedings of the International Agricultural Engineering Conference and Exhibition*. (Bangkok, Thailand: 1990: 3-6 December)/edited by VM Salokhe and SG Ilangantilebe. Bangkok: Asian Institute of Technology, 705-714.

A low capacity (40 kg/h) screw press (oil expeller) was imported from the UK for adaptation to Indian conditions. Prior to adaptation, the press was evaluated for different oilseeds including groundnut. Since the press did not give encouraging output with raw groundnut kernels, the samples underwent various pre-treatments in order to optimize oil recovery and press capacity. The pre-treatments and their interactions influenced the performance of the press significantly. Analysis of data revealed that soaking for 60 min in hot water (80°C) followed by sun drying to about 7.20% m.c. (w.b.) was optimum and gave an oil recovery rate of 82.43% (total oil basis) at a capacity of approx. 5 kg/h. The total cost of processing 1 kg of groundnut and the total cost of

producing 1 kg of oil was Rs. 1.45 and Rs. 4.24, respectively

50 JAVED, K. 1991. Design, fabrication and performance study of two points foci parabolic concentrator. Agriculture Univ., Faisalabad (Pakistan). Dept. of Physics. 81 p.

51 KACHRU, RP. 1991. A pneumatic emptying device for a flat-bottomed grain storage bin. *Journal of Agricultural Engineering Research (United Kingdom)*, 49: 4, 299-310.

52 KACHRU, RP. [1985] Development of niger seed separator: Part I - some physical properties of various fractions in niger seed stock. *Indian Society of Agricultural Engineers. Proceedings of the silver jubilee convention. V. 3. Process, food and dairy engineering.* (Bhopal, India: 1985: 29-31 October). Bhopal, India: Indian Society of Agricultural Engineers, 162-166; 5 ref.

Some physical properties (size, shape, specific gravity, terminal velocity and 1000 grain weight of various grains present in niger seed stocks) were determined to help in designing a niger seed cleaning machine. Length appeared to be one property which could be exploited in indented cylinder or disc separators for removing spherical dodder seed from the niger seed.

53 KACHRU, RP; SHERIFF, JT. 1992. Performance evaluation of axial-flow vegetable seed extractor. *Indian Journal of Agri. Engineering*, 2: 1, 37-40.

54 KACHRU, RP; SRIVASTAVA, PK; DESHPANDE, SD; OJHA, TP. 1988. Using agro-processing equipment in enhancing rural industrialization in India - case studies. *Agricultural Mechanization in Asia, Africa and Latin America*, 19: 2, 55-62.

The status and prospects of using small-scale post-harvest equipment developed in India for processing agricultural products in rural areas are discussed. Costs, working capital, break-even point, return on investment and employment generation per unit investment are assessed for 50 pieces of equipment. Case studies of a pedal-operated air screen seed cleaner and a maize sheller are presented with reference to cost economics.

55 KANAKA PRASAD RAO, K; THIUPAL, K. 1991. Seedcane cutting machine. *Indian Sugar*, 41: 2, 125-126.

A seed sugarcane cutting machine operated by a 0.5 h.p. single phase electric motor or oil engine is described. It consists of a 30 cm diam. circular saw which

rotates at 2000 rev/min to cut cane stalks pressed against it into setts. Operating principles are described. The machine weighs approx. 50 kg and is easy to transport. Two operators can cut 4500-5000 setts/h using the machine with no mechanical damage to the setts.

56 KULKARNI, SD. 1990. Developments in food legume processing machinery. *Agricultural Engineering Today*, 14: 5, 6, 34-46; 33 ref.

Research efforts to reduce pulse crop milling losses in India are reviewed. Hand and power operated machines for processing pulse crops are described. The power operated abrasive rice polisher, under runner disc (URD) sheller and cylinder concave dehuller showed the best commercial potential in performance tests. A study of the effects of grain parameters and environmental factors on pulse processing are recommended.

57 KULKARNI, SD. 1989. Pulse processing machinery in India. *Agricultural Mechanization in Asia, Africa and Latin America*, 20: 2, 42-48; 18 ref.

A review of pulse processing machinery in India is presented. Cleaners, graders, separators, dehuskers, splitters, polishers, driers, conveyors, elevators and oil/water treatment plants are covered.

58 KUMAR, D; TIWARY, S; PANDEY, PH. 1990. Development of thin layer dryer to study drying characteristics of paddy under controlled conditions. *Journal of the Institutions of Engineers India - Agricultural Engineering*, 70: No. AG2, 27-29.

Mechanical drying is often essential in India due to prevailing weather conditions during harvesting and other socio-economic parameters. Development of a scale reduced model of a thin layer drier to study the drying characteristics of paddy under controlled laboratory conditions was undertaken. The machine was successfully developed and tested incorporating advantages such as autoweighing during the test and precise control of drying temp. and air flow rate. The efficiency of drying was also maintained at a higher level compared to others by suitably designing insulation to minimise heat loss.

59 KUMAR, S; NATH, V. 1993. Storage stability of aonla fruits - a comparative study of zero-energy cool chamber versus room temperature. *Journal of Food Science and Technology - Mysore*, 30: 3, 202-203.

Physiological loss in weight, decay and loss of vitamin C content were considerably less in fruits stored under zero-energy cool chamber as compared to those stored

at room temperature. Under zero-energy cool chamber, the fruits of 'Chakaiya' cultivar can be stored upto 12 days with acceptable minimum decay and quality loss, as against 4 days at room temperature.

60 LAL, BB; THAKUR, NS. 1994. Influence of ambient and evaporation cool chamber storage condition on the quality of polythene packed kinnow fruit. 24th Int. Hort. Cong. Kyoto, Japan.

61 MAINI, SB; DIWAN, B; GUPTA, SK; ANAND, JC. 1984. An inexpensive field solar dryer for fruits and vegetables. Indian Food Packer, 38: 77-79.

62 MAINI, SB; DIWAN, SB; GUPTA, SK; ANAND, JC. 1982. Solar dryers for fruits and vegetables. Indian Horticulture, 27: 1, 21-23.

63 MAINI, SB; DIWAN, B; ANAND, JC. 1985. Studies on the comparative efficiency of solar dryers for drying potato chips. Indian Food Packer, 39: 2, 25-28.

64 MANDAL, G; SAMAJPATI, JN; RASHID, MD.A. 1984. Studies on grain storage structures in Mymensingh District, Bangladesh. Agricultural Mechanization in Asia, Africa and Latin America, 15: 4, 50-54; 4 ref., 7 fig., 4 tab.

Wheat, rice and paddy were stored in silos or godowns, in gunny sacks in warehouses and in small, farm-scale containers (bamboo "doles", drums, sacks, boxes). Average losses and deterioration of grains in silo/godown storage were estimated to be 1.5% and for warehouse storage to be 2.8%. Among the existing structures used by the private sector, bamboo-made "dole" was suitable for short-term storage.

65 MANN, HS; SINGH, H. 1992. Comparative performance of sprayers for the control of pest complex on cotton. Journal of Research Punjab Agricultural University (India), 29: 4, 461-466.

66 MASUD, T. 1991. A portable solid state oscilloscope. Agriculture Univ., Faisalabad (Pakistan). Dept. of Physics. 82 p.

67 MENON, ARS; MADHAVAN, K. 1991. Copra dryers - versatile machines for the monsoon periods. Ind. Coconut Journal, Cochin, 22: 1, 6-9.

Copra driers of different capacities were developed in India using the following energy sources: coconut husks, shells or other agricultural wastes; solar energy; and

electricity. The 4 categories of drier were: the smallholder's drier using agricultural waste as fuel (batch-type with indirect heating and natural air convection system); large size copra drier (same principle, larger capacity); solar cabinet drier ('chamber type' with direct heating and natural air convection); and the electrical drier (tray-type drier using mixed flow and forced hot air circulation). Details of design and operation of the 4 types of drier are given and performance data are tabulated and discussed.

68 MIAH, MAK; DOUGLASS, MP. 1992. Storage structures for grains with special reference in Bangladesh. Agricultural Mechanization in Asia, Africa and Latin America, 23: 3, 55-58; 7 ref.

The effect of storage structures and storage periods on the viability of high moisture wheat seeds was investigated. High-moisture wheat was stored in sealed clay bins and plywood bins for 6 weeks; other structures were used as controls. Laboratory studies showed that the m.c. of grain in sealed clay bins remained approx. constant throughout the 6-week period, but in other structures it decreased. However, the temperature of the grain inside the structures increased slowly during the experiment. The viability of re-wetted grain with 23% m.c. fell rapidly after 2, 4 and 6 weeks' storage in the different structures.

69 MISKIN, RB; CHAUDHARY, MS. 1992. Performance of sorghum cobnipper. Indian Journal of Agricultural Engineering, 2: 1, 78-79.

70 NARASIMHA CHAR, BL; AZEEMODDIN, G; ATCHYUTA RAMAYYA, D; THIRUMALA RAO, SD. 1989. Comparative evaluation of three decorticators for mango stone. Acta Horticulturae, No. 231, 751-755.

The OTRI decorticator operates by slashing mango stones with a spiked shaft. It was effective for decorticating both wet and dry stones, and was more efficient, cheaper, less noisy, and consumed less energy than 2 other decorticators tested.

71 NOOMHORM, A; ILANGANTILEKE, SG; ADHIKARINAYAKE, TB. 1990. Comparison of rural farm storage structures based on the milling quality of paddy. 12th ASEAN Grain Post Harvest Programme. (Surabla, Indonesia: 1990: 20-31 August).

72 PAL, RK; ROY, SK. 1988. Zero-energy cool chamber for maintaining post-harvest quality of carrot (*Daucus carota* var. *sativa*). Indian Journal of

Agricultural Sciences, 58: 9, 665-667; 9 ref.

Marketability, freshness and firmness of cv. Nantes carrots could be extended up to 18 days when stored in a 0-energy cool chamber, which maintains lower temperature and higher RH than room temperature storage [see Roy, S.K. et al, *Indian Horticulture* (1982) 27 (1), 5-6]. Carrots became unmarketable within 5 days when stored at room temperature (17-33.5°C). There was considerable shrinkage in roots even in conventional cool storage owing to the low RH. Sugars, carotenoids, crude fibre and polysaccharides increased during the postharvest storage. Roots stored in the 0-energy cool chamber showed less loss in weight than those stored at room temperature and in conventional cool storage. Size, shape and structure of cells of carrots stored in the 0-energy cool chamber were comparable to those of freshly harvested ones. Roots stored at room temperature and in conventional cool store showed shrunk and collapsed cells.

73 PALANIAPPAN, C. 1990. Study on cardamom drying in conventional curing chambers and methods for improving their performance. *Rivista di Ingegneria Agraria*, 21: 2, 75-92; 11 ref.

Methods of improving the thermal performance of cardamom curing systems are discussed, in view of the fact that thermal efficiency of existing drying systems is often 8% or less. Results of a computer simulation program taken from a thermal analysis are examined and proposals for improvements are presented based on field tests on a curing chamber. Improvements in quality may be achieved, bringing 7% higher prices. Economic analyses showed that the payback period for capital investments on modifications is <1 yr. Utilization of drying capacity could be increased by 1.5-2 times/yr.

74 PANDEY, PH; BHOLE, NG. 1990. Design and development of solar tobacco dryer. *Proceedings of the International Agricultural Engineering Conference and Exhibition*. (Bangkok, Thailand: 1990: 3-6 December)/edited by VM Salokhe and SG Ilangantilebe. Bangkok: Asian Institute of Technology, p. 541-551.

A solar tobacco drier (3x6 m) which can dry 100 kg batches of chewing and hookah tobacco was developed and tested. A good quality of tobacco was produced and savings of as much as 43% fuel and 18.7% curing time were achieved. Av. overall operational efficiency of the solar collector was found to be 52%

75 PANNU, CJS; SINGH, S; BHANGOO, BS; SINGH, MP. 1992. Actual use, demand and availability of farm power and machinery in cotton-belt of

Punjab. *Indian Journal of Agricultural Engineering*, 2: 2, 90-97.

76 PATHAK, PK; AGRAWAL, YC; SINGH, BPN. 1991. Thin-layer drying model for rapeseed. *Transactions of the ASAE*, 34: 6, 2505-2508; 21 ref.

Thin-layer drying rates of rapeseed were experimentally determined at 8 levels of drying air temp., 4 in the conventional drying temp. range of 50-93°C and 4 in the elevated temp. range of up to 200°C. A mathematical model of a form of Page's equation was developed. The model predicted the moisture ratios well at the conventional as well as elevated drying temp.

77 PHIRKE, PS; UMBARKAR, SP; TAPRE, AB. 1992. Development and evaluation of a waste fired dryer for red chilli. *Indian Journal of Agricultural Engineering*, 2: 3, 176-180.

78 RAJU, GV; TAKWALE, MG; BHIDE, VG. 1989. Solar dehydration of grapes. *Renewable energy for rural development. Proceedings of the national solar energy convention*. (Hyderabad, India: 1988: 1-3 December)/edited by VVN Kishore; NK Bansal. New Delhi: Tata McGraw-Hill, p. 410-414.

A natural convection solar drier with a loading capacity of 200 kg per batch was developed for dehydration of grapes. Before drying, the grapes were treated in a solution containing ethyl oleate, potassium carbonate and oleic acid. They were then fumigated in sulphur dioxide fumes for 6 h and 200 kg of treated grapes were loaded in the drier. The solar insolation, inlet and outlet temp., tray temp. and wind velocity were measured hourly. The m.c. was measured at the end of each day. The initial m.c. of grapes was 78% and was reduced to 15% within 4 d. The av. drying efficiency was 31.7%

79 RAJU, JN. 1989. An energy efficient drying chamber for FCV tobacco curing process. *Solar and Wind Technology*, 6: 2, 159-163; 2 ref.

A low thermal loss drying chamber was developed to replace the conventional coal-fired barn for drying of flue cured Virginia (FCV) tobacco. Experiments were conducted both on a conventional barn and newly designed chamber with the same load of tobacco by supplying solar, coal and bio-gas energy. The experimental results showed that the heat utilization efficiency of the newly designed chamber is 60% compared with 30% in the conventional chamber.

80 RAMA, MV; NARASIMHAM, P. 1991. Evaporation cooling of potatoes in small naturally ventilated

chambers. *Journal of Food Science and Technology, India*, 28: 3, 145-148; 8 ref.

Short duration (1-3 d) experiments were carried out on evaporative cooling of potatoes, using metallic evaporative cooling chambers (covering the outer walls with wet cloth), with a view to finalizing design details for scaling up to 10 t capacity. Results showed that the rate of cooling during a 24-h period increased in proportion to the increase in surface area of evaporation up to 80%; further increases in the surface area of evaporation to 100% did not show any additional cooling due to direct solar radiation. At the end of 24 h cooling, the temperature dropped to 22.1 from 38.0°C (a drop of 15.9°) and the amount of heat removed was 2658 kJ against a wet bulb temperature of 21.1°. Air circulation inside the evaporative cooling chamber increased the cooling rate to 3.0 kJ/kg per h as compared with 1.65 kJ/kg per h in a non-circulating chamber. Cooling efficiency, in terms of heat removed, increased with the increase in load (one third, two thirds and full capacity).

81 RAMANI, B; KOTHARI, ND. 1990. Drying of bagasse by exergy dryer. *Bharatiya Sugar*, 16: 1, 141, 143, 145, 147, 149-151.

Tables show the effects of moisture content of sugarcane bagasse (35-50% or 20-50%) on: calorific value of the bagasse; volume of combustion gases; combustion temperature; heat transmitted to steam, and weight of steam produced/kg bagasse. In the 'exergy dryer' developed in Sweden, drying is achieved using steam at high pressure, generating steam at lower pressure for use in other units of the factory. Particular advantages of exergy drying over drying with flue gas are: easier operation and control, low nett energy consumption (since no hot gases are wasted), no particulate emission to atmosphere, and no fire hazard or danger of explosion. Drying with flue gas decreases the efficiency of a boiler + economizer, but exergy drying increases it. Exergy drying can economically decrease the moisture content to 12-15%, giving much more efficient combustion and greater compatibility with high-pressure boilers.

82 RANA, PN; GANESH, KC. 1977. Report on the studies of different types of storage structures in Nepal. *Nepalese Journal of Agriculture*

83 RAO, CG; SINGH, CP; BHATNAGAR, AP. 1993. Optimum operating time for cleaning of cane sugar juice evaporators in sugar mills. *Jrl. of Food Sc. and Tech. - Mysore*, 30: 5, 349-354.

Studies were conducted for determining optimum operating time for cleaning of cane sugar juice evapora-

tors in sugar mills. The overall heat transfer coefficient decreased with time of operation of evaporators and increase in incoming juice Brix. The overall heat transfer coefficient and time of operation gave a straight-line relationship for both the evaporators under study. At the present operating conditions, the optimum operating time for maximum heat transfer in K1 and K3 evaporators was found to be 1800. It is sufficient enough to clean the evaporators only once during the entire cane crushing season of the mill. It is, thus, possible to save nearly 50 tonnes of bagasse and also detergents for cleaning the evaporators, in addition to the increase in the life of the evaporators.

84 RAO, KKP; THIRUPAL, K. 1990. Sugarcane cutting machine. *SISSTA Sugar Journal*, 16: 3, 23.

The machine consists of a circular saw of 30 cm diam. made of 16 gauge alloy steel. The circular saw is coupled to the electric motor or oil engine by means of a V belt and pulleys with a set of self aligned ball bearings. When the power is generated the circular saw makes 2000 rev/min, 1800 m e/min causing the cane stalks (when pressed against the rotating circular saw) to be cut into setts. A delivery channel is provided for the setts to pass directly into the baskets or gunny bags kept in position. The machine weighs about 50 Kg and can be transported conveniently in a rickshaw, bullock cart or in a jeep.

85 ROY, SK; PAL, RK. 1993. A low cost cool chamber - an innovative technology for developing countries. *Proc. of Int. Conf. on Postharvest Handling of Tropical Fruit*. (Thailand: 1993: 19-23 July).

86 ROY, SK; PAL, RK. 1991. A low cost zero energy cool chamber for short term storage of mango. *Acta Hort.*, 291: 519-524.

87 ROY, SK; KHURDIYA, DS. 1982. Low energy cool chambers for horticultural produce. *The First AFST (India) International Food Conference*. Bangalore, India.

88 ROY, SK; KHURDIYA, DS. 1981. Storage of horticultural produce in zero energy cool chambers. *The 2nd workshop on Post-Harvest Technology of Horticultural Crops*. (IARI, New Delhi: 1981: 3-4 Dec.).

89 ROY, SK; KHURDIYA, DS. 1987. Studies on evaporatively cooled zero energy input cool chamber for storage of horticultural produce. *Indian Food Packer*, 40: 6, 26-31.

90 ROY, SK; CHAKRABARTI, AK; PAL, RK. 1990. Zero-energy cool chamber an effective on farm storage structure of potato. *National Symp. on Strategies for Potato Production, Marketing, Storage and Processing*. New Delhi. p. 50.

91 ROY, SK. 1991. Zero energy cool chamber a possible solution of problems of post harvest losses during handling and marketing of tropical fruits. *International Symp. of Tropical Fruits*. (Thailand: 1991: 20-24 May).

92 ROY, SK. 1985. Zero energy cool chamber. *IARI Research Bulletin*, No. 43. Indian Agricultural Research Institute, New Delhi.

93 SAMAJPATI, JN; PEDERSEN, TT. 1988. Modern food grain silos in Bangladesh. *Agricultural Mechanization in Asia, Africa and Latin America*, 19: 4, 49-52; 4 ref.

Losses in bulk grain silos in Bangladesh were investigated. Estimated av. losses due to deterioration were 7.7% over 6-12 months, reaching 20% in government silos.

94 SARMAH, BN; GOYAL, GK; SINGH, J. 1989. Influence of atmospheric and vacuum roller drying systems on the physico-chemical properties of buffalo whole milk powder. *Egyptian Journal of Dairy Science*, 17: 2, 359-372; 16 ref.

Buffalo milk, concentrated to 20 and 25% TS, was dried by atmospheric (ARD) and vacuum (VRD) roller drying at steam pressures of 50 and 60 lb/in². Milk dried by ARD had higher solubility index, wettability and mean particle size, but lower bulk density, dispersibility and sinkability than had that dried by VRD, and was more brownish in colour. Method of drying had little effect on fat or titratable acidity of the dried milk, but that dried by ARD had lower moisture, and considerably higher hydroxymethyl furfural (HMF) and free fat contents than that dried by VRD. Moisture, HMF and free fat content of the dried milk were significantly affected ($P < 0.01$) by method of drying, steam pressure and TS content of the conc. milk.

95 SEHGAL, VK; ARORA, S. 1994. Performance evaluation of a husk fired furnace. *Int. Journal of Tropical Agriculture*, 12: 1, 2, 52-59.

96 SEIFELNASR, YE. 1991. Suweba (Mud Bin) storage of grains in the Sudan. *Indian Journal of Entomology*, 53: 3, 494-502.

97 SHANKARA, R; ANANTHACHAR, TK; NARASIMHA, HV; KRISHNA MURTY, H; DESIKACHAR, HSR. 1984. Improvements to the traditional edge-runner process for rice flake production. *Journal of Food Science and Technology, India*, 21: 3, 121-122; 4 ref.

Low yield of rice flakes in the traditional method of flaking is attributed to losses by breakage and powdering in the edge-runner. An additional idle roller was fitted to the edge-runner. This reduced the flaking time from 60 to 40 s and also the breakage from 5 to 3%, and at the optimum paddy moisture content of 22% just before flaking, consequently increased the yield from 65 to 67%. A small roller flaker was developed with an effective roller length of 10 cm and tested for performance at roller diam. of 15, 20.5, 28.5 and 27.5 cm and speeds of 600-700 cm/s and capacity of 40-50 kg/h. The optimal diam., peripheral speed and hardness were 30 cm, 650 cm/s and 500 BHN (Brinell hardness number), respectively. Capacity and power consumption of the small roller flaker/unit length are comparable to those of corn flaker (4.75 kg/h and 0.13 kW/cm length). A small roller flaker with the edge-runner will facilitate fine flaking of coarse flakes, and increase the yield of flakes to 70%. The processing cost for the traditional process was 42 paise, traditional process with 2 idle rollers was 35 paise, traditional process with roller flaker as adjunct was 37 paise and for the continuous process 28 paise/kg of flake produced.

98 SHARMA, MP; SINGH, PR. 1992. Development of tractor front mounted double row sugarcane windrower harvester. *Indian Journal of Agricultural Engineering*, 2: 2, 102-105.

99 SHARMA, RN. 1988. Standardization efforts in agricultural engineering. *Agricultural Mechanization in Asia, Africa and Latin America*, 19: 2, 77-81.

Standardization in India in agricultural engineering is discussed with particular reference to the areas of farm power, crop production equipment, horticultural and forestry equipment, on-farm water management, post-harvest technology, livestock husbandry and energy. Safety, comfort and ergonomic studies are stressed. Standardization at regional and international levels is described.

100 SHRIVASTAVA, M; NGOMIDIR, M; PANDEY, PH. 1990. Design and development of a low cost solar chilli dryer. *Proceedings of the International Agricultural Engineering Conference and Exhibition*. (Bangkok: 1990: 3-6 Dec)/ed. by VM Salokhe and SG.

Ilangantilebe. Bangkok: Asian Inst. of Technology, p. 505-515.

A low cost solar cabinet type drier with overall dimensions of 1450 x 1463 x 805 mm was designed to dry 25 kg of chillies. The total solar collector area is 1.17m² and the drying cost is Rs. 23.32/d. Comparative studies on the effect of bed thickness showed that drying time increases with increase in bed thickness while the moisture reduction pattern for any bed thickness is similar. Drying time was found to be half that of sun drying.

101 SHYAM, M; SINGH, R; SINGH, VASUDEV. 1991. **Development of oscillating sieves seed potato size-grader.** *Journal of the Indian Potato Association*, 18: 1-2, 61-67; 8 ref.

Prototypes of hand and power-operated oscillating sieve potato size graders and a flat belt feed conveyor attachment were developed and used satisfactorily for sorting seed potato tubers. The construction, method of operation, field performance and economics of these graders are given. On average, the graders sorted 20-28 q/h of seed potatoes into 3-5 size grades, employing 9-12 attendants. The sizing efficiency ranged from 80-90% and av. tuber damage was within 2%. The operating costs of the power grader were lower, particularly when annual use was high.

102 SIMS, H. 1993. **Economic imperatives, political risks, and modes of action: agricultural policy implementation in India and Pakistan.** *Journal of Developing Areas (USA)*, 27: 2, 145-161.

103 SINGH, G; SINGH, OP. 1993. **Relative efficiency of hand and machine-placed urea and urea super-granules in transplanted rainfed lowland rice (*Oryza sativa*).** *Indian Journal of Agricultural Sciences*, 63: 11, 728-30.

104 SINGH, JP. 1991. **Deep urea hydrolyser implemented successfully at IFFCO-Phulpur.** *Fertiliser News*, 36: 7, 31-34.

A deep urea hydrolyser system has been designed and implemented at a urea plant which removes ammonia and urea from waste water effluents. The system contains three major parts: a hydrolyser, preheaters, and hydrolyser pumps with a suction catchpot and related piping/instrumentation. Salient design features are highlighted. Benefits of this system include not only reduced environmental pollution, but also monetary savings through recovery of ammonia and urea and reuse of treated water.

105 SINGH, KK; SHUKLA, BD. 1992. **A potato pulper for starch extraction.** *Indian Journal of Agricultural Engineering*, 2: 1, 25-31.

106 SINGH, M; GARG, M; REHSI, SS. 1990. **Durability of phosphogypsum based water-resistant anhydrite binder.** *Cement and Concrete Research*, 20: 2, 271-276.

Data are presented on the durability of a phosphogypsum based water-resistant anhydrite binder as affected by weathering under conditions of alternate wetting and drying as well as heating and cooling cycles at temperatures of 27-60°C. Strength of the binder is reduced and wt loss increases with increase in exposure temperature. There is a drastic reduction in strength at 45°C. As compared to the plain hemihydrate plaster, the binder, however, shows much lower fall in strength and wt loss.

107 SINGH, MP; THAKUR, TC; BACHCHAN SINGH. 1987. **Preliminary investigations on utilisation of animal power for operating a paddy thresher.** *Utilisation and economics of draught animal power. Proceedings of the national seminar on the status of animal energy utilisation.* (Bhopal, India: 1987: 24-25 January)/edited by NSL Srivastava; TP Ojha. Bhopal, India: Central Institute of Agricultural Engineering, p. 234-243; 11 ref.

An animal-power complex was developed to operate various rotary powered systems, e.g. thresher, chaff cutter, oil expeller, flour mill, feed grinder, etc. It is based on a mechanical gear reduction unit driven by a pair of animals. Preliminary tests of the unit while operating a loop type paddy thresher gave encouraging results. The cost of threshing and cleaning was Rs. 6.37/quintal grain, compared with Rs 4.62/quintal for manual threshing. The physiological responses of the animals (temp., respiration, pulse) were well within maximum capacities and the animals showed no signs of fatigue over 2 h of continuous operation.

108 SODHA, MS; RAM CHANDRA; KAMNA PATHAK; SINGH, NP; BANSAL, NK. 1991. **Techno-economic analysis of typical dryers.** *Energy Conversion and Management*, 31: 6, 509-513.

Techno-economic analysis of typical grain driers with different kinds of energy sources showed that the plastic solar collectors with a life of 5-10 yr are the cheapest among all the energy systems. The conventional collectors with a lifetime equal to or more than 20 yr are, however, economical when compared with wood, oil and electricity.

109 SULAIMAN, ED; HUSAIN, SS. 1985. Survey of fungi associated with stored food grains in silos in Iraq. *Pakistan Journal of Scientific and Industrial Research*, 28: 1, 33-36; 18 ref.

When 291 samples of stored wheat, barley, rough and polished rice and maize were collected from 16 silos/godowns of stored food grains in different cities throughout Iraq, 28 storage and 33 field fungi were encountered. *Aspergillus* and *Penicillium* spp. predominated, comprising 12 *A. spp.* (including *A. glaucus* and *A. flavus* groups and some possible new spp.) and 11 *P. spp.* *Rhizopus* and *Mucor spp.* were also present. Among field fungi *Alternaria* (most prevalent), *Fusarium*, *Cladosporium*, *Curvularia*, *Stemphylium* and *Cochliobolus* and other less common fungi were isolated.

110 SUNDARESAN, A; ARUMUGHAN, C; PRASAD, KVS; DAMODARAN, AD; NAMPOOTHIRI, KUK. 1990. Design of indigenous small scale edible palm oil extraction unit. *Proceedings - PORIM international palm oil development conference - chemistry, technology and marketing*. (Kuala Lumpur: 1989: 5-9 Sep). Kuala Lumpur: PORIM, p. 81-88; 9 ref.

A commercially viable small scale palm oil extraction unit to suit the requirements of Indian planters has been designed. The unit, which could process 1 t fresh fruit bunches (FFB) per h, consisted of a waste fired boiler, horizontal sterilizer, rotary drum stripper, bucket elevator, digester, hydraulic press, overflow clarifier, high speed centrifuge and other accessories. All the equipment and accessories were fabricated/procured from indigenous sources as per the design requirements. Based on the performance and yield data of oil palm plantations in India, this unit could cater for a 200-ha oil palm plantation. The unit has been in operation since it was commissioned in Dec. 1988. Data from 20 batches showed a mean value of 20% palm oil extract on FFB. It further demonstrated the feasibility of extracting high grade palm oil with less than 2% free fatty acids in the small sector. The high grade raw palm oil with acceptable physico-chemical attributes, is being evaluated for edible use in view of the high level of carotenes. Techno-economic feasibility and design of small scale palm oil extraction units in the Indian context are discussed.

111 SWAIN, S; OJHA, TP. 1985. Machinery selection concerning farm sizes. *Agricultural Mech. in Asia, Africa and Latin America*, 16: 4, 69-72.

Computer algorithms based on network analysis and on

applications of dynamic programming were used to determine the optimum and near-optimum cost combinations of farm machinery for use in India's paddy fields for harvest and post harvest operations. Only 25 preferred policies from a large number of combinations were obtained for each farm size. The use of high capacity machines were not feasible in small holdings, while a particular method or machine for optimum conditions on a small scale enterprise was eliminated in a large farm due to low capacity. The combination of power tiller harvester, power tiller operated thresher with sundrying seemed to be the suitable combination for holdings in 5-14 ha range.

112 TAJUDDIN, A; BALASUBRAMANIAN, M. 1992. Evaluation of a low volume knapsack spinning disc sprayer. *Indian Journal of Agricultural Engineering*, 2: 3, 159-163.

113 TARMANA, RD; FAROOQ, M; CHAKKAPHAK, C [et al.] 1991. Agricultural machinery demand in Indonesia, Pakistan and Thailand. *RNAM Newsletter*, No. 41, 12-13.

Agricultural machinery demand in Indonesia, Pakistan and Thailand is discussed. In Indonesia a survey was conducted to determine the demand for walking tractors in Tangerang, Bojongoro and Pati districts and for power threshers in Tangerang. Figures for the projected demand for these machines between 1991 and 1995 are presented. In Pakistan, an estimation model was developed to determine the demand for selected agricultural machines considering the price, operating costs, credit facilities, literacy rate of farmers, availability of labour and farm power, area planted to a particular crop and production target. The model was used to project the demand for wheat threshers, wheat seed drills and cotton planters between 1991 and 1995. In Thailand a survey was conducted to determine the demand for some important agricultural machinery and data for the projected demand of single axle/two wheel tractor, axial-flow propeller pumps, paddy threshers and mechanical and manual sprayers are presented.

114 THAKUR, KS; LAL, BB. 1994. Quality changes during refrigerated and evaporator cool chamber storage of kinnow fruit. *Int. Hort. Cong.* Kyoto, Japan.

115 THANGARAJ, T; IRULAPPAN, I. 1988. Effectiveness of hot water treatment, waxing and cool chamber storage in prolonging the shelf life of mango. *South Indian Horticulture*, 36: 6, 327-328; 6 ref.

Mature green fruits of the cultivar Neelum were treated in different ways and stored in a cool chamber. Fruits were assessed for physiological weight loss and shelf-life (days taken for 10% spoilage) and the data are tabulated. Least weight loss (2.3%) and the longest shelflife (9.7 days) were obtained with hot water treatment ($52 \pm 1^\circ\text{C}$) + waxing + 10% Frutox + cool chamber storage.

116 THANVI, KP; PANDE, PC. 1989. A low-cost tilted type solar dryer. *Renewable energy for rural development. Proceedings of the national solar energy convention*. (Hyderabad: 1988: 1-3 December)/edited by VVN Kishore; NK Bansal. New Delhi: Tata McGraw-Hill, p. 405-409; 3 ref.

A low cost solar drier for dehydrating 10-15 kg of fruit/vegetables was designed and developed. The main feature of the device is its maximum energy capture by keeping the system at an optimum tilt according to latitude and season of operation. Performance studies showed that m.c. of 10kg of chillies was reduced from 83 to 5.5% within 5 days and the efficiency of the drier was 15.2%

117 THANVI, KP; PANDE, PC. 1989. Development of inclined solar dryer with alternate materials. *Renewable energy and environment. Proceedings of the national solar energy convention*. (Udaipur: 1989: 1-3 Dec)/ed. by AN Mathur; NS Rathore. Udaipur: Himanshu Publications, p. 41-45.

The design details and performance of an inclined solar drier for maximum energy capture, which can be used for dehydrating 30 kg of fruit and vegetables, are described. In a field test, the m.c. of chillies was reduced from 82 to 7.2% within 5-6 d. The efficiency of this drier is about 13%

118 VERMA, SR; HARI SINGH; KALKAT, HS; SINGH, H. 1992. Design aspects and performance of an axial-flow vegetable seed extracting machine. *Agricultural Mechanization in Asia, Africa and Latin America*, 23: 2, 21-24, 28; 5 ref.

The design of an axial-flow vegetable seed extraction machine is described in detail. Ripe fruits are sliced and crushed in the machine and the seeds are separated from the pulp by water sprinkling jets. The seeds are collected on a concave screen. The machine was tested on ripe fruits of seven common Indian vegetables and its performance was compared to that of manual seed extraction. The machine facilitates vegetable seed extraction and is cheaper and faster than traditional manual methods. The axial-flow vegetable seed extrac-

tion machine is suitable for the wet seed extraction of most Indian vegetables.

119 YADAV, RNS; YADAV, BG. 1992. Design and development of CIAE bullock-drawn reaper. *Agricultural Mechanization in Asia, Africa and Latin America*, 23: 2, 43-46, 51; 13 ref.

A simple, rugged oxen-drawn reaper was designed and developed for harvesting cereals, pulse crops and oil seed in India. It is a lightweight machine requiring less draught than earlier designs of bullock-drawn reapers. The crops harvested by the machine are delivered in uniform bunches behind the cutter-bar. The special feature of this reaper is the transformation of low soil thrust developed from the traction wheel into a greater force for cutting crops by means of crank and lever mechanism at the cutter-bar. The field capacity is 0.12-0.14 ha/h and the harvesting losses are less than 5% of total crop yield.

120 ZAIDI, MA; ZAFAR, AW; SABIR, MS. 1992. A mathematical model for repair and maintenance cost of agricultural machinery. *Agricultural Mechanization in Asia, Africa and Latin America*, 23: 3, 70-72; 7 ref.

A mathematical model for repair and maintenance costs of farm machinery was developed. Model parameters for tractors, threshers, trailers and cultivators were found. The model estimates repair and maintenance costs, proportional to the initial cost of the machine, and can be adapted for other machines and locations if data are available. However, the model only gives an estimation of repair costs and large variations can occur from one farm to another due to differences in operating practices, machinery management, maintenance routine and machine operation.

PACKING MATERIALS

121 ANAND, JC; MAINI, SB. 1982. Fibreboard packaging for fruits. *Indian Hort.*, 27: 19-22.

122 BADGUJAR, CD; LAWANDE, KE; KALE, PN. 1987. Polythene packing for increasing shelf-life in brinjal fruits. *Current Research Reporter, Mahatma Phule Agril. Univ.*, 3: 2, 22-25; 2 ref.

Packing of brinjal (*Solanum melongena*) fruits in polyethylene bags (20 X 25 cm, 200 gauge with 1% vent) prolonged shelf-life compared with unpacked fruit in all the 7 varieties evaluated. Aruna and 10-1-62 performed best, being acceptable up to the 12th day of storage with 18.6 and 18.8% weight loss, respectively.