

Small-scale maize milling : ILO WEP 1984

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Introduction

There are various types of shelling equipment, each type catering to differing scales of production and conditions (e.g. domestic use, co-ownership by small farmers, use by independent farmers on a daily hire basis, ownership by custom or merchant mills). Farmers often use small, hand-cranked, rotary shellers which are usually simple, effective, inexpensive and fairly durable. They are available from many manufacturers from both developing and industrialised countries. A priori, any developing country should be able to manufacture this type of shellers. The latter are of various designs, and made from a small number of iron castings. They utilise a spiked disk to prise out the grain while the cob is held by an adjustable spring-loaded pressure plate. While the capacities of different machines vary, these will at least double the rate of the most productive hand-held devices (e.g. 100 kg of grain per hour).

The larger, free-standing shellers are more productive and convenient, but more expensive. They are often fitted with cleaning and separation devices for the removal of unwanted material. The relatively large size of the maize grain facilitates the use of both cleaning fans for the blowing away of dust and light particles, and of simple reciprocating sieves for the removal of sand, stripped cob centres and broken or undersized grain. Depending on the type of sheller and on the number of operators employed, the capacity of these machines can be four times larger than that of the smaller rotary shellers. This may be explained by the use of low-friction bearings and of simple gearing which result in steady and high operating speeds. The shelling principles are similar to those of the smaller shellers. One main difference is the replacement of the spring-loaded pressure plate by a relatively low speed feed roller which forces cobs into the shelling element. The design and sizing of large shellers allow the use of alternative drive methods, such as small electric or petrol motors. These shellers are suitable for small-scale merchant mills.

The full-sized, diesel or electrically-powered shelling machines, with capacities of several tonnes per hour, represent the normal equipment used in large-scale, fully mechanised situations. A large number of firms produce their own designs for sale through normal agricultural equipment suppliers. No standardised design exists, but most shellers use broadly similar operating principles. These shelling machines are available in a variety of installations. Use within a mill requires a fixed installation, with associated handling and feeding facilities fitted close by. Mobile installations are also available. They are either wheeled or mounted on tractors. The high rates of throughput require the use of cob loading elevators and bagging equipment. Most shellers utilise a pegged drum, mounted on a horizontal shaft, which rotates at about 700-1,000 rpm. A concave metal screen, with holes approximating to the size of the grain, is located around the drum. It contains the cobs while shelling takes place. A baffle plate restricts the flow of the cobs, and maintains the required shelling

pressure. A strong fan discharges the stripped cob centres and other large debris. A second, smaller fan is often used at the grain discharge point for the removal of the remaining dust and finer particles. Available information indicates that an average shelled grain output of 900 kg/hr/installed kWh may be obtained from these shellers.

Dehusking of the cob may be carried out with a special device installed within the shelling machine. The usual method of dehusking is to provide sets of contra-rotating rollers whose projections pull the husk away from the cob. It is possible to shell and husk maize, despite some loss of capacity, within the shelling section itself. However, it is recommended to obtain the advice of individual manufacturers on the practicability of this approach.

The working lifetime of the various components of these machines should be relatively high since no wearing or rubbing parts are employed. Thus, the need for spare parts, such as bearings, drum parts and screws should be relatively low. However, differences in materials of construction do occur and no typical replacement rates can be quoted. No skilled labour is required to run these machines since it is only necessary to manually feed the cobs and dispose of the grain and cob centres. The number of labourers employed has a pronounced influence on the work rate of the machines, particularly that of the smaller units with unmechanised loading.

1 Hand-held shelling devices

A number of hand-held devices have been developed with a view to improving labour productivity, reducing the tedium of work and minimising finger soreness. The hourly output of shelled grain achieved by these devices ranges from 8 kg to 15 kg per hour. Figure III.1 shows a number of hand-held devices developed in recent years. Table III.1 provides information on the designers/producers of these devices, the main construction method and skill requirements, their relative production cost and the estimated hourly output. It may be noted that all of these devices may be produced by local workshops using imported or locally available materials.

2 Small rotary hand shellers

These shellers are particularly suitable for small-scale production. They are effective and usually quite robust. Their operation is fairly simple, although grain damage may result from inadequate adjustment of the equipment. The turning of the handle forces the cob to rotate against the spikes of a disc which removes the grain. Available designs allow for the separation of the spent cob centre from the grain. This, however, requires that the owner improvise a mounting stand and grain collection facility. Designs from various manufacturers differ in surface finish, quality of alignment and material, and in the thickness of metal. These variations result in different outputs ranging from 14 to over 100 kg per hour. Whilst these shellers are best made in metal, it is possible to produce similar equipment from wooden constructions. They may be manufactured locally by skilled craftsmen and entrepreneurs.

Table III.1

Characteristics of hand-held shelling devices

Sheller type	Source	Description	Construction	Construction skill required	Relative cost (local manufacture)	Capacity kg/hr
Decker	See manufacturers list	See illustr.				15
Morogoro	Prof. A.S. Ramo, University of Dar-es-Salaam, "Appropriate Technology", Vol. 2, No. 1, May 1975	See illustr.	Using saw timber	Fairly high	High	13
Ceneema	"Bloc-notes du monde rural", No. 13, June 1977, B.P. 790, Yaounde (Cameroon)	See illustr.	Welded construction	Fairly high	Medium	10
TPI	"Rural Technology Guide No. 1", 1977, Tropical Products Institute, London	See illustr.	Wooden carving	Low	Low	10
PVC Pipe	Dr. D.J. Hilton, University of Nairobi, "Appropriate Technology" Vol. 3, No. 2, Aug. 1976	See illustr.	Glued PVC piping	Low	Low	8
SATA	Swiss Association for Technical Assistance, P.O. Box 113, Kathmandu, Nepal	As Decker	Folded sheet	Fairly high	Medium	As Decker

Manufacturers from both developing and industrialised countries produce a large range of rotary hand shellers. Some of these may be adjusted for different sizes of cobs, and can be mounted on various frames. Plates III.1 to III.6 provide a brief description of some of these shellers for illustrative purposes. The quoted prices of some of the shellers are purely indicative. The reader may also wish to obtain information on other shellers from manufacturers mentioned in Appendix I.

3 Free-standing hand shellers

The free-standing hand shellers are relatively large and complete shelling machines. They are substantially more expensive than the smaller rotary shellers, but much more productive and easier to operate. The method of grain removal is similar to that for the small shellers, but includes some modifications to improve the capacity of the machine, (e.g. use of a flywheel and of mechanical cob feed rolls). These shellers are invariably fitted with a simple grain cleaning screen or winnowing fan, and have a positive separation of grain and spent-cob. They may be operated in a variety of ways for capacities ranging from 40 kg/hr (single hand operation) to 300 kg/hr (using a small motor and two operators). The design of these shellers varies from one manufacturer to another.

APPENDIX I: EQUIPMENT MANUFACTURERS AND SUPPLIERS

The equipment manufactured and/or supplied by the firms listed below is designated by the following letters:

- HH : Husking hooks
- RHS : Rotary hand shellers
- FSHS : Free standing hand shellers
- PS : Powered shellers
- PM : Plate mills
- HM : Hammer mills
- SM : Stone mills
- RM : Roller mills
- VFD : Ventilated floor dryers
- ISD : In-storage dryers
- BD : Batch dryers
- CD : Continuous dryers

Manufacturers/Suppliers

Equipment

BELGIUM

DDD President,
Chaussde Dikkebus, 487,
8904 YPRES

SM

BRAZIL

Irmaos Nogueira SA., CIMAG Ltda, Av. Ipiranga 1071, SAO PAULO	PS
Laredo S.A., Rua 1 de Agosto, 11-67 CEP 17100 BAURU (SP)	PS, HM
<u>DENMARK</u>	
ABC Hansen Comp. A/S., P.O. Box 3054, DK 1508 COPENHAGEN V	PM, SM
Erling Foss Export, Thorsgade 59, DK-2200 COPENHAGEN N	SM
United Milling Systems Ltd., 8 Gamle Carlsberg vej, DK-2500 VALBY; COPENHAGEN	RM
Skjold, P.O. Box 39, DK 9300 SAEBY	HM, SM
<u>FEDERAL REPUBLIC OF GERMANY</u>	
AMOS Maschinenfabrik GmbH, Postfach 1160 D-7100 HEILBRONN	RHS, PS
Iruswerke Dusslingen J. Rilling & Sohne, Postfach 128, D-7401 DUSSLINGEN	SM
<u>FRANCE</u>	
Argoud SECA Le Mottier 38260 LA COTE ST-ANDRE	PM, HM
Ets. Champenois, S.A., Chamouilley, 52170 CHEVILLON	RHS, FSHS, SM
Ets. Claudien Beroujon, 280, rue des Alpes, 38290 LA VERPILLIERE	SM
Soci COMIA-FAO, S.A., 27, bd de Chateaubriand, 35500 VITRE	PS, HM, SM
Electra,	HM

Poudenas, 47170 MEZIN	
Ets. A. Gaubert, 22, rue Gambetta, B.P. 24, 16700 RUFFEC	SM
Goudard, 77260 LA FERTE SOUS JOUARD	HM
Law SECEMIA, B.P. 15, 5, ave. du Gral de Gaulle, 60304 SENLIS CEDEX	HM, RM
Moulis, 80800 MONTREDON LA BESSONIE	PM
PROMILL, B.P. 109 28104 DREUX	HM
Renson et Cie., B.P. 23, 59550 LANDRECIES	RHS, FSHS, PS, PM, SM
SAMAP, 1, rue du Moulin, B.P. 1 Andolsheim 68600 Neufbrisach	PM
Ets. Simon Frs, Rue Laurent Simon B.P. 171, 50104 CHERBOURG CEDEX	SM
Tixier Frs, 18120 LURY SUR ARNON	PM, HM
<u>HONG KONG</u>	
China National Machinery Import and Export Corporation, RHS c/o China Resources Company, Bank of China Building, HONG KONG	
<u>INDIA</u>	
Allied Trading Company, Railway Road, AMBALA CITY 134 002	RHS, PS
Binny Engineering Company, Meenambakkam, P.O. Box 1111, MADRAS 600 001	RM

Cossul & Co. Ltd., Industrial Area 123/367, Fazal gang, KANPUR	RHS, FSHS
Dandekar Brothers, Shivaji Nagar SANGLI (Maharashtra)	RHS
Dandekar Machine Works, Bhiwandi, 1-421 302 Dist. Thana, MAHARASHTRA	RHS, PS, SM
International Manufacturing Co., Hospital Road, Jagraon, LUDHIANA (Punjab)	PS
Kisan Krishi Yantra Udyog, 64 Moti Bhawan Collectorganj, KANPUR 208 001	HM, PM
Numex Engineers, P.O. Box 820, BOMBAY 400 001	PM
Rajan Trading Co., P.O. Box 250, MADRAS 600 001	PM
Rajasthan State Agro Industries Corp., Ltd., Virat Bhawan, C-Scheme, JAIPUR 302 006 (Rajasthan)	RHS
Union Forgings, GT Road, Focal Point, Shepur LUDHIANA	FSHS
<u>ITALY</u>	
Ceccato Olindo Machine Snc., Via Giustiniani 1, 35010 ARSEGO (PD)	RHS, FSHS, PS
Favini & Co., Industria Meccanica, Via Provinciale 13, Fornova, BERGAMO	RM
OCRIM Spa., Via Massarotti No. 76, CREMONA	RM

IVORY COAST

S.A.C.M.
16, rue des Foreurs,
B.P. 4019
ABIDJAN

PM, HM

JAPAN

CeCoCo Ltd.,
P.O. Box 8,
IBARAKI CITY, OSAKA 567

RHS, FSHS

KENYA

Ndume Products Ltd.,
P.O. Box 62,
GILGIL

HM

MALAWI

Brown and Clapperton Ltd.,
P.O. Box 52
BLANTYRE

RHS, HM

NETHERLANDS

Ten Have Engineering bv
Industrieweg 11,
Postbus 27,
7250AA VORDEN

HM

PHILIPPINES

Guanko Ironworks,
102-104 Mj Cuenco Avenue,
CEBU CITY

RM

SENEGAL

SISMAR (Ex. SISCOMA)
Rue du Dr. Theze & Grammont
B.P. 3214
DAKAR

FSHS, HM

D. Seek,
KEBEMER

HM

C. Gueye
GOSSAS

HM

SWITZERLAND

Buhler Bros Ltd.,
CH-9240 UZWIL 4

RM

TANZANIA

Ubungo Farm Implements,
P.O. Box 2669

RHS

DAR ES SALAAM

UNITED KINGDOM

Alvan Blanch Development Co., Ltd.,
Chelworth
MALMESBURY, Wiltshire SN16 9SG

PS, PM, HM, VFD

E.H. Bentall & Co. Ltd.,
MALDON, Essex CM9 7NW

PM, HM, VFD, ISD, CD

Christy & Norris Ltd.,
Broomfield Road,
CHELMSFORD CM1 1SA

HM

Colman & Co. (Agricultural) Ltd.,
Ballingdon Works,
SUDBURY, Suffolk CO10 6BY

VFD, BD

Cornercroft (Agriculture) Ltd.,
CONINGSBY, Lines LN4 4SN

VFD

R. Hunt and Co. Ltd.,
Atlas Works,
Earls Colne,
COLCHESTER, Essex CO6 2EP

RHS, FSHS, PM

Kamas Machinery Ltd.,
110 Hunslet Lane,
LEEDS, Yorkshire LS10 1ES

CD

Law-Denis Engineering Ltd.,
Lavenham Road,
The Beeches Industrial Estate,
Yate,
BRISTOL BS17 5QX

ISD, CD

R.A. Lister Ltd.,
Dursley
GLOS GL11 4HS

VFD, ISD

Miracle Mills, Ltd.,
Franklin Road,
LONDON SE20 8JD

HM

Ransomes, Sims & Jeffries Ltd.,
IPSWICH, Suffolk IP3 9QG

PS, FSHS

Scotmec Ltd.,
42-44 Waggon Road,
AYR (Scotland)

HM

Henry Simon Ltd.,
P.O. Box 31,
STOCKPORT, Cheshire SK3 0RT

HM, RM

Turner Grain Handling Ltd.,
Benezet Street,

CD

IPSWICH, Suffolk 1P1 2JQ
John Wilder (Engineering) Ltd.,
Hithercroft Works,
WALLINGFORD, Oxon OX10 9AR

BD

UNITED STATES

Bryant - POFF Incorp.,
P.O. Box 127,
COATESVILLE, Indiana 46121

PS

Jacobson International Inc.,
2445 Nevada Avenue North,
MINNEAPOLIS, Minnesota 55427

HM

Raidt Manufacturing Co.,
SHENANDOAH, Ohio

HH

Seedburo Equipment Co.,
1022 West Jackson Blvd.,
CHICAGO, Illinois 60607

PS, RHS