

Design of small-scale catfish processing plants in Alabama



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*Information contained herein is available to all persons
without regard to race, color, sex, or national origin.*

Design of Small-Scale Catfish Processing Plants in Alabama

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INTRODUCTION

THE APPARENT unsatisfied local demand for processed catfish and increased catfish production on small farms inaccessible to large processing plants has created a need for small-scale processing plants. Such plants can be constructed inexpensively, unlike high-volume, mechanized plants which involve high capital investment. Plant design and operation must comply with the Alabama Department of Public Health regulations and be coordinated through local Health Department authorities. Maximum processing volume will probably not exceed 50,000 pounds per week if fish are machine skinned or 10,000 per week if fish are skinned manually.

This publication describes guidelines for the design and operation of a small-scale catfish processing plant.

PLANT LOCATION

Local zoning regulations must be followed when locating the plant. The plant should be conveniently located so it is accessible to the incoming fish (from owner's pond or other sources), to customers, and to plant workers. If well water is to be used in the processing operation, the plant should not be built near an animal feedlot, septic tank drain field, or the like, which could pollute the well with fecal bacteria. An area should be available near the plant for an effluent oxidation pond (aerobic lagoon). The plant site should be well drained. Access, parking, and loading areas should be surfaced with an all-weather material such as gravel.

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WATER SOURCE

Water for washing dressed fish, equipment, and hands of workers should be free from pollution (less than 4 coliform bacteria per 100 ml). Usually well water or city water is the most convenient source. The volume of water for the plant operation should be at least 1,500 gallons per 1,000 pounds of live fish. Water can be checked for suitability by local health authorities. Any plant having more than 25 workers must meet the requirements of the "Safe Drinking Water Act of 1977" (Act. 805).

BUILDING DESIGN AND CONSTRUCTION

A floor plan for a plant, permitting 8-10 people to hand-process (head, skin, eviscerate, wash, and ice pack) up to 500 pounds per hour, is shown in figure 1. The building contains 330 square feet of processing floor space, an office, storage room, insulated chill or refrigerator room for storing ice and iced fish, restroom (two are required if male and female workers are employed), and an area for storage of offal. There must be two doors between the processing room and the restroom. A handwashing lavatory with hot and cold water must be located in every room where unpackaged food is handled.

The plant should be constructed of materials that have smooth, washable, nonabsorbant inside surfaces of light color. Wooden surfaces should not be used. Concrete blocks, painted inside with an epoxy waterproof compound, or metal materials can be used for the walls. Floors should be concrete finished with a sealant. The ceiling should be waterproof, nonabsorbent material of light color. Windows and doors must be screened. The building should be sealed completely to prevent entry of rodents, flies, and insects. Doors should have self-closing attachments. The floor should slope toward drains which have removable covers. Four-inch diameter drains are required in floors that will be washed down.

Adequate overhead lighting is necessary. Fifty foot-candles of light intensity should fall on all work surfaces. Artificial lighting fixtures must be shielded to protect against broken glass. Electrical outlets and fittings should be waterproofed. Ventilation is necessary and may be provided by screened windows or louvers.

The chill room, with mechanical refrigeration to maintain a temperature of 38°F, may be prefabricated or built-in. It should have an indirect drain so the ice melt flows into the processing floor drains and not directly into the drain line. The ice maker should also have an indirect drain. Partitions are required to separate processing functions (skinning, etc.) from packaging. The office and dry storage floors should be raised 6 inches.

[5]

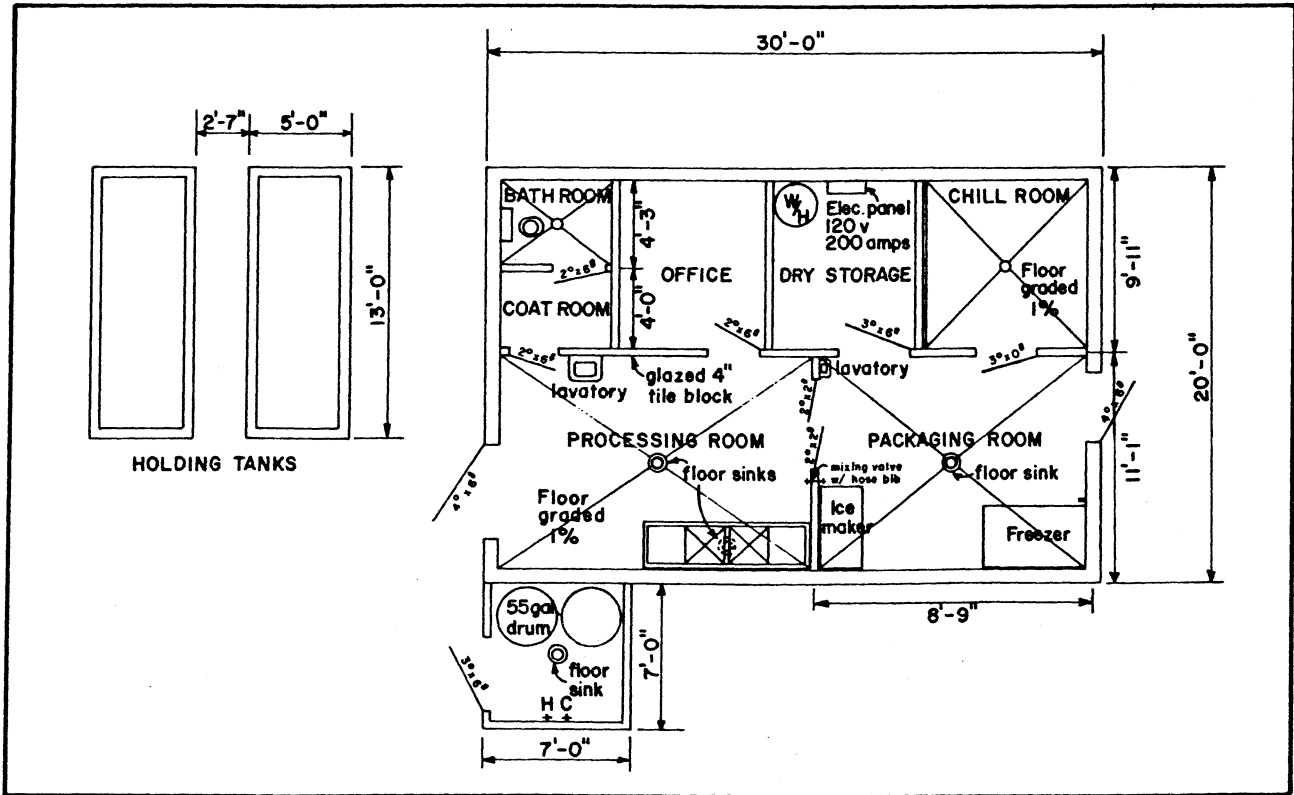


FIG. 1. Floor plan of a catfish processing plant that can employ 8-10 persons and process 500 lb. per hour by hand skinning, Mustin, 1979.

The offal storage room should have a concrete floor with drain and be completely screened and rodent-proof. A properly drained concrete slab, with hot and cold water plumbing for washing the waste containers, is required.

EQUIPMENT

A three-compartment, stainless steel sink with drainboards for washing equipment is required. The sink should be installed over a floor drain with a 3-inch air gap, figure 2, between the sink drain pipe and the floor drain cover. A water heater (approximately 80 gallon size) is necessary for hot water for cleaning and for the hand wash basin.

Work tables should be moveable with tops of smooth, nonporous, and noncorrosive material. Stainless steel is best for table tops; formica is acceptable, but wood is not. A sink or vat with running water is usually located in the processing line for washing the dressed fish. Additional vats are needed if the dressed fish are ice-chilled prior to packing.

An ice maker may be justified depending upon the volume of ice used and the cost of commercial ice. About a pound of ice per pound of dressed fish is necessary for chilling and ice-packing. Packing containers must have a nonporous surface. Wax-coated paperboard boxes with polyethylene liners are available for ice-packing fish. A 21-cubic foot freezer should be provided for holding frozen fish.

Catfish skinning machines costing \$5,000-\$6,000, figure 3, are available if the volume of fish processed each day is large enough to

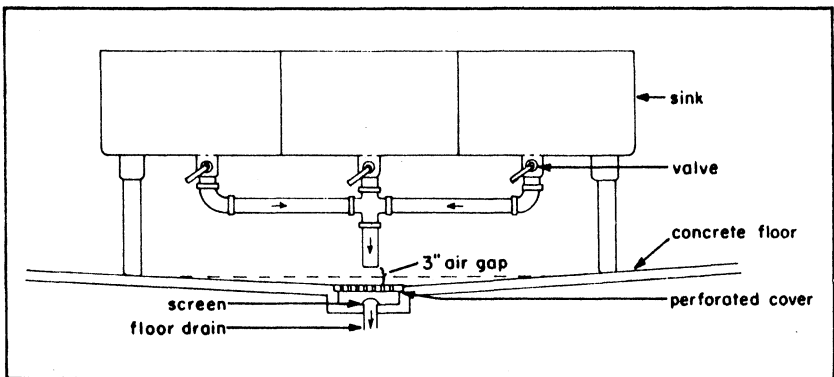


FIG. 2. Sink located over a floor drain with air-gap between sink drain pipe and the floor drain.



FIG. 3. A semi-automated skinning machine can be used if the volume of fish processed is large enough. One operator with this machine can skin approximately 800 fish per hour.

justify their use. One machine with one operator can skin about 800 fish per hour, or with two operators this volume can be doubled. Other personnel are needed to head, gut, and trim the fish. When a skinning machine is used, a band-saw for heading is recommended, such as the one in figure 4 which costs \$1,500-\$2,000.

If 2,000 pounds of live fish or less are processed per day, machine skinning is probably not feasible. By hand-skinning, one person can completely dress an average of 50-75 fish per hour. A rack over the

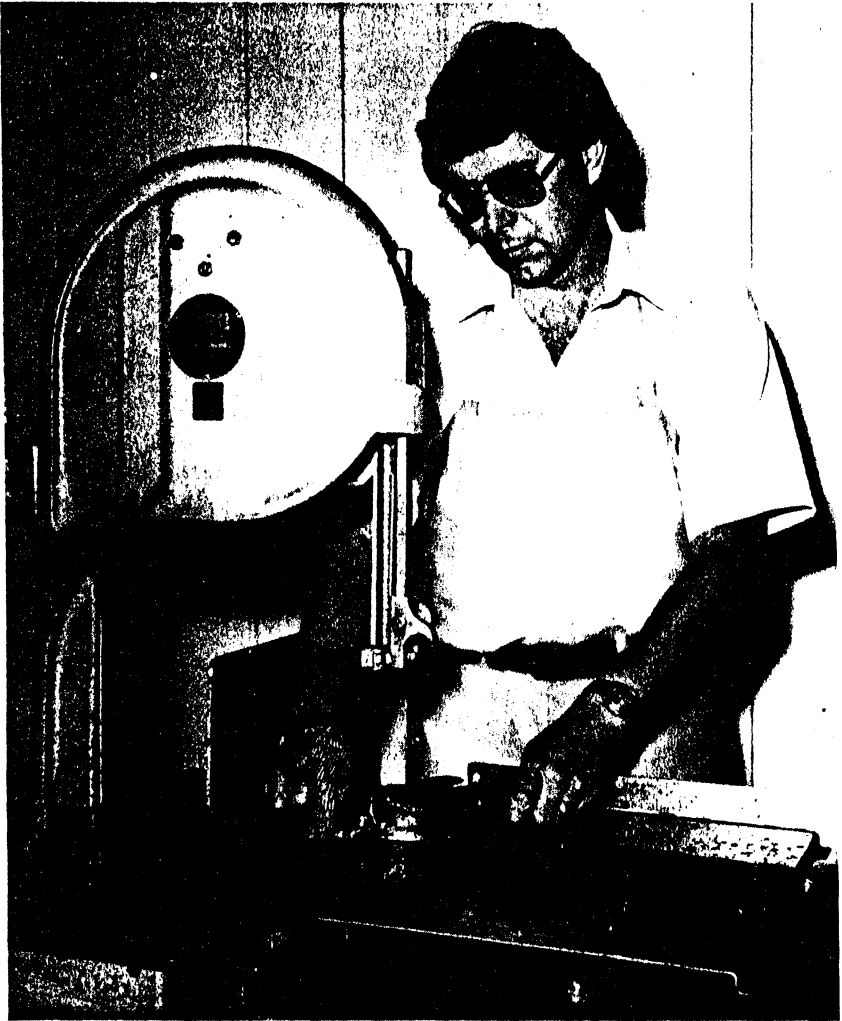


FIG. 4. A band-saw for heading fish is necessary when skinning is done by machine.

table for holding fish for the skimmers, such as shown in figure 5, is helpful.

One or two tanks for holding live fish outside the plant prior to processing are needed. The tanks can be concrete or portable, but should be equipped for rapid filling and draining. They should have electrical aerators or running water.

A facility for stunning the fish before processing is necessary. A metal basket in the holding tank, wired to stun the fish electrically, is



FIG. 5. A rack above the work table is used for holding the fish for hand-skinning. One person can head, skin, and eviscerate 50-75 fish per hour by this method.

a popular technique. It can be dangerous, so a qualified electrician should install the facility.

BUILDING AND EQUIPMENT COSTS

A 1980 cost estimate of a processing plant of the dimensions shown in figure 1 and made of concrete blocks is presented in table 1. Cost of the building, holding tanks, well, and an aerobic lagoon is \$16,360. Also presented in the table are equipment costs which, not including skinning machine or skinning rack, amount to \$9,685. Total estimated investment amounts to \$26,045. This does not include costs of harvesting or delivery equipment.

**ESTIMATE OF CONSTRUCTION AND EQUIPMENT COSTS FOR A CATFISH PROCESSING PLANT
MADE OF CONCRETE BLOCKS AND FOLLOWING THE FLOOR PLAN
SHOWN IN FIGURE 1.¹**

Description	Cost (\$)
Construction:	
Well, casing, pump (1.5 hp)	3,000
Aerobic lagoon (0.5 acre) 600 cu. yd.	560
Building (564 sq. ft. floor area) plus offal storage area; includes: ..	12,000
Site preparation, 4 in. gravel fill	
4 in. concrete slab with drains	
Concrete blocks for outside walls	
4 in. glazed tile blocks for inside partitions	
1/2 in. plywood ceilings	
Ceiling insulation	
Plumbing, electrical: fixtures and installation	
Epoxy paint for inside walls, ceiling	
Septic tank, drain field	
Holding tanks (2)	800
Total construction	16,360
Equipment:	
Walk-in refrigerator, 8' x 8' x 8'	3,000
Ice machine, 1,000 lb./day, flaked	2,500
Chest freezer, 21 cu. ft.	500
Stainless steel tables (2) 12' x 30"	1,750
Stainless steel sink, 3 compartment, heating element, 2 drain boards (18" x 18" compartments, 18" drain boards)	335
Beam scale, 1,000 lb. capacity	500
Electrical shocker	300
Miscellaneous: baskets, tubs, knives, scales, storage shelves	800
Total equipment	9,685
Total capital investment	26,045

¹Based on 1980 costs.

PROCESSING

A flow diagram of the steps in processing catfish is shown in figure 6. Catfish can be transported to the plant alive or iced. Iced fish are slightly harder to skin and don't bleed as well and the meat sometimes appears slightly darker. However, as long as the fish are thoroughly iced this is an acceptable method of transport, especially if the fish cannot be conveniently transported alive.

Live fish are sunned before entering the plant. If machine skinners are used, workers do specialized jobs such as heading, gutting, skinning, and trimming. In hand-dressing, workers may also do specialized jobs, but most often one worker will skin, head, gut, and trim.

Chilling in an ice bath after washing is a good practice. This cools the fish faster which results in improved keeping quality; it also reduces the amount of ice required in packing. Ice-packed, dressed fish keep fresher than those stored non-iced in a refrigerator because cooling is faster and more uniform (if the ice is well mixed with the

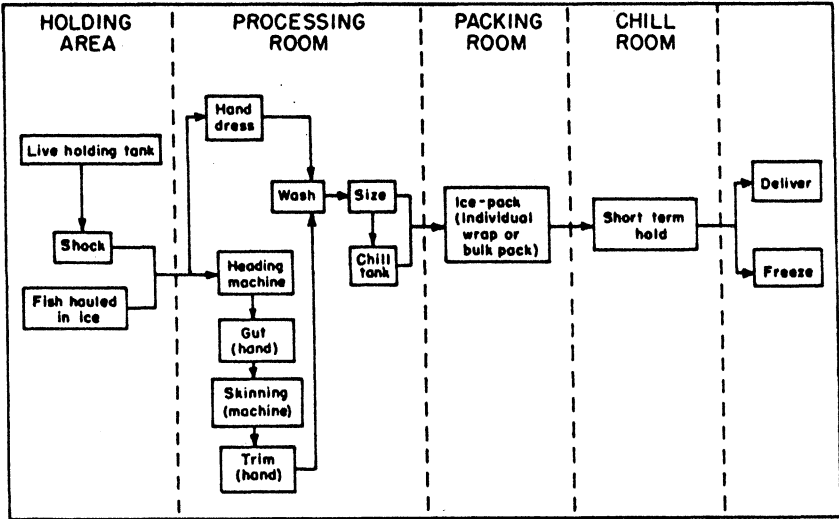


FIG. 6. Flow diagram for processing catfish. Options presented are machine or hand skinning, precooling with a chill tank or direct icing, and marketing frozen or in ice-pack.

fish) and a lower holding temperature can be maintained. Research studies showed that ice-packed, dressed catfish kept well for 12 days compared with 7 days for non-iced, refrigerator-stored catfish, (Lovell and Ammerman, 1977). The ice-packed fish are stored in the insulated chill room.

If the fish are pre-chilled, approximately 0.5 pound of ice per pound of fish will be sufficient for packing the fish stored in a refrigerated room. If not pre-chilled, the fish require an additional 0.006 pound of ice per pound of fish per 1°F above 35°F. This means that 1 pound of non-chilled dressed fish will require 0.8 to 1.0 pound of ice in summer and 0.6 to 0.75 pound of ice in winter for packing.

EFFLUENT AND WASTE DISPOSAL

Water from the processing operation must flow through an oxidation pond before being discharged into streams. Oxidation ponds and any positive discharge to surface waters must be approved by the Alabama Water Improvement Commission. Effluent from the restrooms should flow into a septic tank with a field drain. Specifications for the septic tank should be obtained through the county representative of the State Department of Public Health.

The processing waste (head, skin, viscera) must be disposed of daily. It can be spread as fertilizer on fields away from the plant,

buried, transported to a rendering plant, or fed to pigs. The waste has good nutritional value and when supplemented with an equal weight of corn makes an excellent pig ration, Lovell and Ammerman (1). However, feeding of unprocessed fish waste to pigs is prohibited by Alabama Law (Act 613, Regular Session, 1969) unless the pigs are raised for home consumption.

The waste, usually in 55-gallon drums, is held in the waste holding room outside the plant until its disposal. If it is to be held for more than 1 day, a refrigerated holding room is necessary.

COMPLIANCE WITH STATE LAWS

The Alabama Department of Public Health is responsible for the design and operation of all food processing in Alabama. Plans for a catfish processing plant, regardless of size, must be presented for approval to a representative of the Department of Public Health. Wastewater disposal from the plant must be approved by the State Water Improvement Commission.

LITERATURE CITED

- (1) LOVELL, R. T. AND G. R. AMMERMAN. 1974. Processing Farm-Raised Catfish. So. Coop. Ser. 193. 59 pp.
- (2) MUSTIN, W. G. 1979. An integrated Approach to Small-Scale Harvesting, Processing, and Marketing Channel Catfish. M.S. thesis, Auburn Univ., Auburn University, AL. 48 pp.