

## A GUIDE TO EXTRUSION



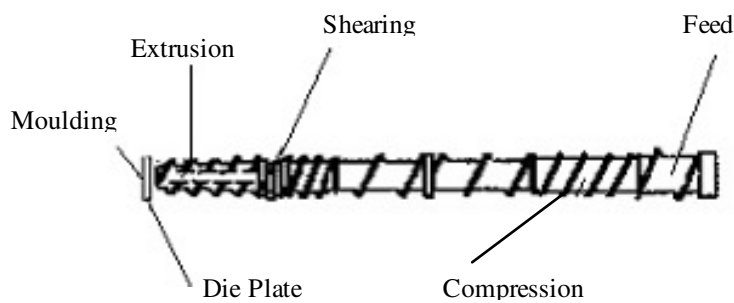
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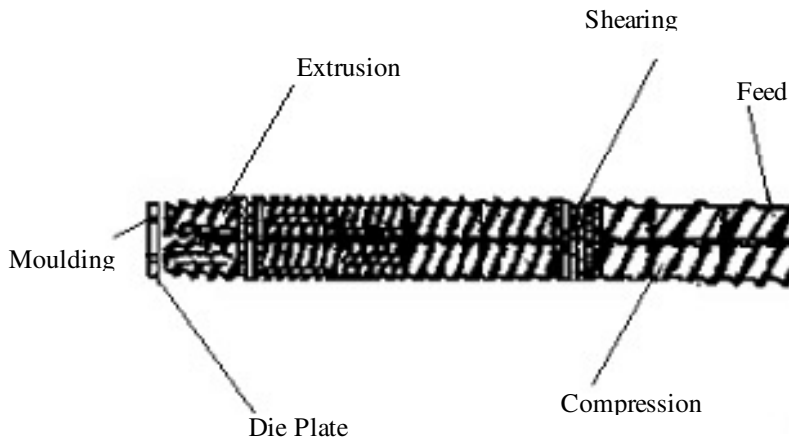
## EXTRUSION PROCESS

Feed ingredients are propelled along the barrel of the extruder by one or two screws. The mechanical screw action and the friction it creates blends, shears and cooks the material. (Held at 120-175°C for about 30 seconds). At the end of the barrel, the mixture is forced through a die at high pressure. Because of the difference between pressure inside and outside of the barrel, the material expands, and according to the die shape and the cutter blade action, it creates a pellet of varying size, shape and density NB: density is dependant upon water content: see section on conditioning).

### a) Single Screw



### b) Double Screw



## **PREPARATION OF RAW MATERIALS**

Most materials require milling prior to extrusion, especially large granular ingredients like Maize or Soya. Whereas Soya is sent directly to the extruder, in the case of a complete feed ration such as fish or animal feed, mixing will be required to ensure homogenous, evenly distributed end product. After extrusion, cooling is required to remove excess moisture. (To prevent fungal activity, a moisture content of 12-14% should be achieved.

### **Some benefits of extrusion as follows: -**

- The heat and pressure created in the barrel can destroy harmful organisms such as salmonella.



- The raw material is expanded; Starch is gelatinised and oil cells are ruptured (improved digestibility in young animals).
- The heat and pressure deactivate destructive enzymes such as those that cause rancidity.
- Increase availability of carbohydrates.
- Neutralises growth inhibitors.
- Increase availability of sulphur amino acids.
- Improves palatability.

## TYPES OF EXTRUDER

### Alvan Blanch Single Screw Extruder



*Location: Akin Sateru Farms, NIGERIA*

The single screw extruder is an entry-level machine for small-scale operations. A large proportion of the expanded animal feed and modified raw materials such as soyabean and corn for feed purposes use single screw extrusion. The heat required to successfully cook the material relies upon the mechanical energy applied to the ingredients. This extruder is normally incorporated in a complete system with a hammermill, mixer and cooler, see the example below.



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## Alvan Blanch Twin Screw Extruder



A twin-screw extruder has two screws running in parallel with intermeshing flights for increased performance. Expansion of the ingredients is still limited without the introduction of additional heat and moisture. These extruders are therefore normally supplied with either a water mixer or steam conditioner for superior gelatinisation and expansion, by raising the moisture content of the mix to 20-25% prior to entering the extruder, or in the case of steam extrusion, the temperature of the material is also increased to approximately 55-65°C prior to entering the extruder barrel. This is controlled using metering systems and injected either into the preconditioner or sometimes directly into the barrel of the extruder. A higher amount of thermal energy can be supplied in this way in addition to the mechanical energy needed to cook the product. Steam conditioning maximises capacity (increase of up to 40%) and expansion of pellets thereby improving the floatability of the pellet.

### **Some Technical Benefits of the Alvan Blanch Twin Screw Extruder:**

- Better ability to produce fish feed pellets on lower cereal percentage in the ration (allows higher protein feed to be used).
- Self-cleaning; the action of the twin screws helps to self-clean the barrel. (whereas with the single screw it is sometimes necessary to strip out and clean the barrel, especially if the machine is shut down before becoming empty).
- Homogeneity of the product is improved through the twin-screw action.
- Ability to operate with smaller hole dies in order to produce smaller pellets.

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**EXTRUDED FEEDS**

There are three main categories of feed that can be produced with an extruder.

**a) Full Fat Soya**



**b) Aqua Feed**



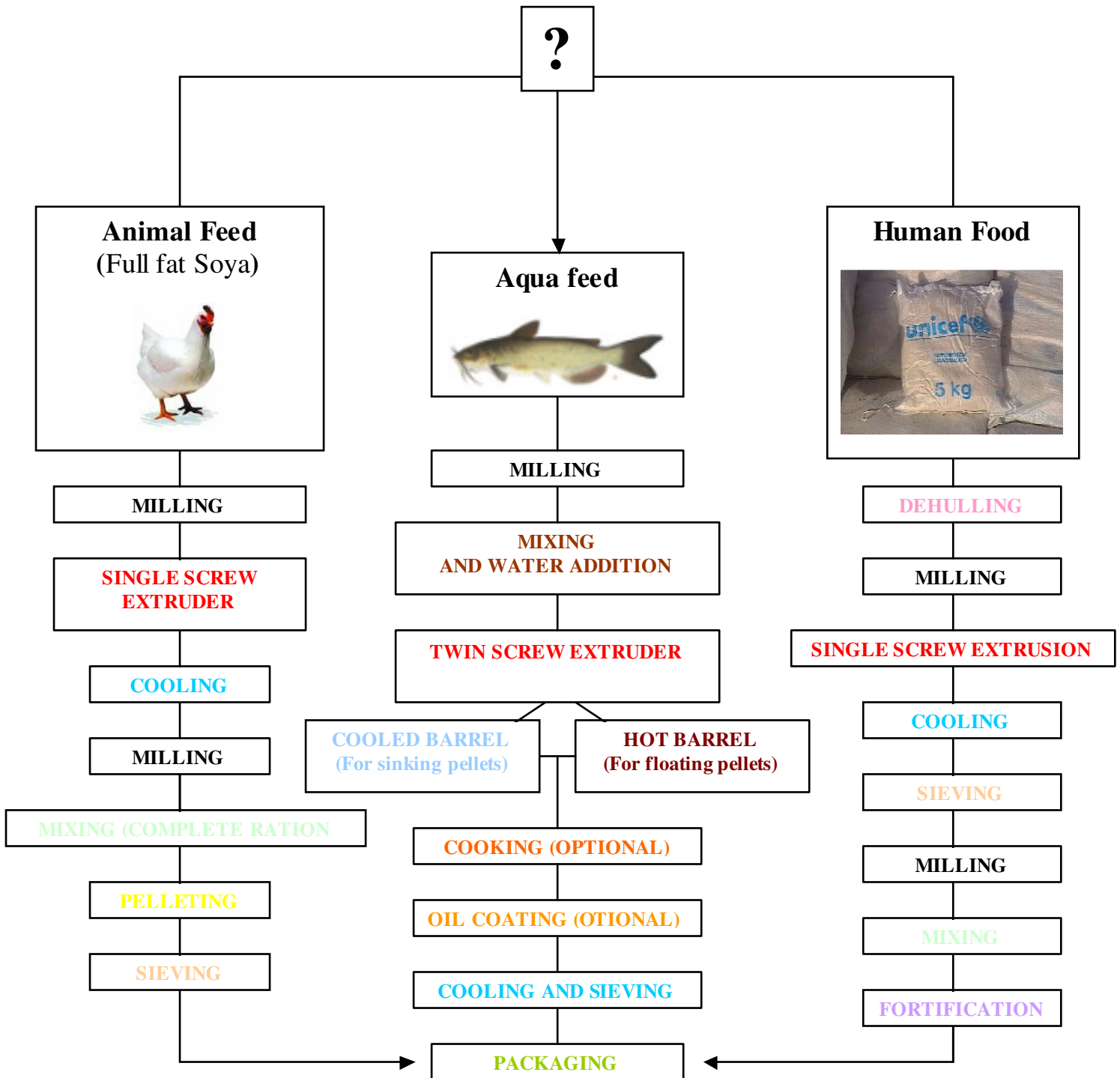
**c) Human Food**



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## EXTRUSION PROCESS

To help select the right machine/ process, follow the flow diagram below.



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## **FULL FAT SOYA**



Soyabean meal is the main source of protein in animal feed formulation, mainly in poultry feed, (also other young animals like pigs). However, unprotected soybean contains anti-nutritional factors, which inhibit animal growth and reduce the nutritional value. Dry extrusion with a single screw is sufficient to deactivate the trypsin inhibitor. The soyabean first requires milling prior to extrusion. This can be performed with a normal hammermill (using 3mm Screen.) In poultry feed (broiler) the extruded Soya is approx 10% of the total feed ration. After extrusion it is normally hammermilled, mixed and either fed in a mash form, or pelleted for improved FCR (Feed conversion ratio).

Extruded oilseeds such as Full Fat Soya are both high energy and high protein raw materials. If adequate energy in the form of lipids is provided then the use of more costly protein can be minimised. Protein is more efficiently utilised at increased levels of lipid in the diet. Marine fish oil are rich in the fatty acids readily digested by fish but the energy density can be increased by the addition of vegetable oils rich in linolenic and linoleic acids. Indeed, many fish have limited ability to synthesise these fatty acids and they must therefore be incorporated in the diet.

## RELIEF FOOD

Generally these are simple foodstuffs designed to provide a basic level of nutrition to human populations in disaster or famine conditions. Mainly based on cereals fortified pre-cooked the material and neutralises ANFs (Anti-nutritional factors). Vitamins, and minerals etc may be added downstream after extrusion and before packaging.



Containerised mill for World Food Programme, Tanzania.

## AQUACULTURE



Many fish farms feed their stock by sprinkling mash feed, or using conventional pellets that quickly break up on contact with water resulting in a high percentage of wastage and water pollution.

As we have described, extrusion involves compression and cooking of mixed feed; a process that gelatinises the starch for improved digestibility, sterilises it for food security and at the same time changes the cell structure so that the bulk density becomes lighter. A die at the end of the extrusion chamber enables the extruded product to be shaped into pellets that expand as they leave the die, thus creating the floating effect that is required for most fish stocks. Alvan Blanch can produce pellets of differing densities; sinking (by cooling the barrel to reduce expansion) or fully floating pellets (by heating to produce maximum expansion. Typically die sizes range from 1mm (Shrimp) to 3.5mm (catfish). The pellets expand upon leaving the die by approximately 50%. Raw ingredients should be ground to approximately 30% of pellet size. In order to improve the quality and acceptability of the fish feed, addition of 3-5% fish oil is highly recommended



To be assured of success and for maximum quality; gelatinisation, structure and palatability, the best approach is full steam conditioning with an Alvan Blanch twin-screw extruder.

**For your all your animal feed milling requirements, please contact us at our address below: -**