

Production of Petfood using the Expander/Extruder OEE

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1 Introduction

Dogs are carnivores and their digestive system is by 2/3 shorter than that of pigs. Therefore, the nutritive components have to be of high quality, rich in energy, and easy to digest, in particular the vegetable components. Apart from natural food such as waste from the butcher's shop, industrially produced

- canned wet food,
 - moist food (semidry), and
 - dry food
- are offered.

In most cases dry food is pelleted, extruded, or flaked, and often mixtures are offered, too. Dry food contains cereals or by-products of cereals.

As the enzymatic degradation of native starch in the digestive system is difficult, the starch is to be modified.

The Kahl extruder is used for the production of a dry extruded complete food for dogs covering the total nutrient requirement. Table 1 shows the nutrient requirement of different breeds (sizes) of dogs in the different stages of life. The level of metabolizable energy (ME) is by abt. 25 % higher than that of broiler or pig feed.

Tab 1 Analysis of nutrients of extruded dry dog food

Dog-size		MINI	MEDIUM	MAXI
	Weight (kg)	1 - 10	10 - 25	25 - 80
Junior	Age (months)	2 - 10	2 - 12	2 - 18
	Protein (%)	33	32	36
	Fat (%)	20	20	14
	Starch (%)	24	25	26
	Energy (ME kcal)	4300	4300	3960
Adult	Age (years)	1 - 8	1 - 7	1.5 - 6
	Protein (%)	27	25	26
	Fat (%)	16	12	16
	Starch (%)	36	42	38
	Energy (ME kcal)	4120	3920	4140
	Food/day (g)	180	350	850
Senior	Age (years)	8 - 16	7 - 14	6 - 12
	Protein (%)	27	25	26
	Fat (%)	16	12	16
	Starch (%)	36	42	38
	Energy (ME kcal)	4130	3930	4120

2 Process description

2.1 Characteristics of the Kahl expander/extruder

Fig.1 On the left: extruder outlet, in the middle: last paddle of the expander, on the right: annular gap outlet

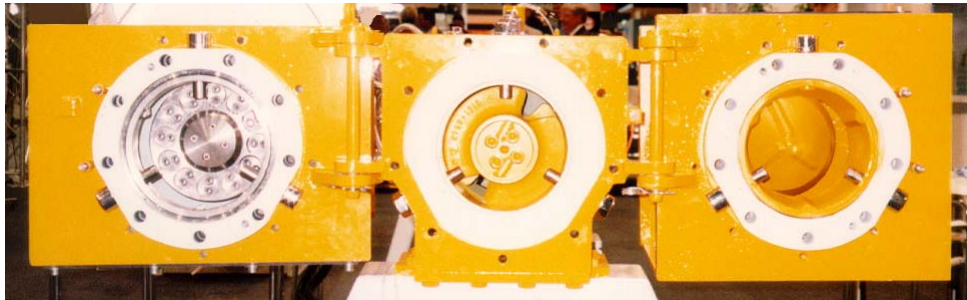
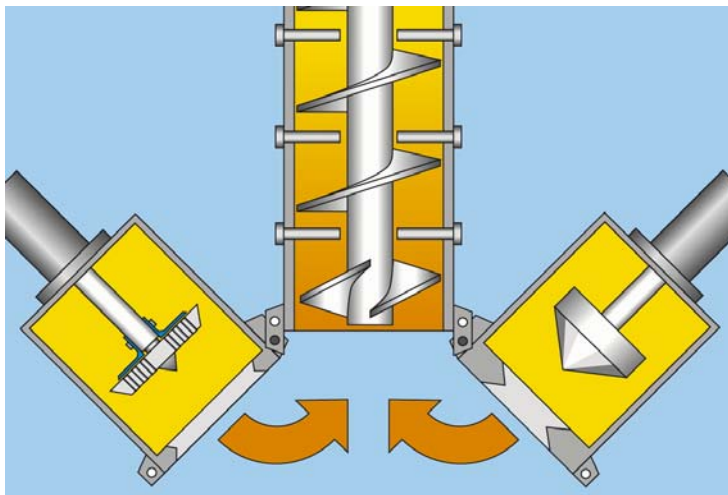


Fig.2 Illustration of the expander with die and annular gap outlet



- high flexibility (variety of products) due to the exchange of the expander/extruder outlet head
 - annular gap (Expandat, crumbles)
 - die (extruded product, defined shaping)
- single-shaft pin extruder
- casing jacket which can be heated and cooled
- short starting and shut-down periods
- hydraulically adjustable die (prevention of blocking of the machines)

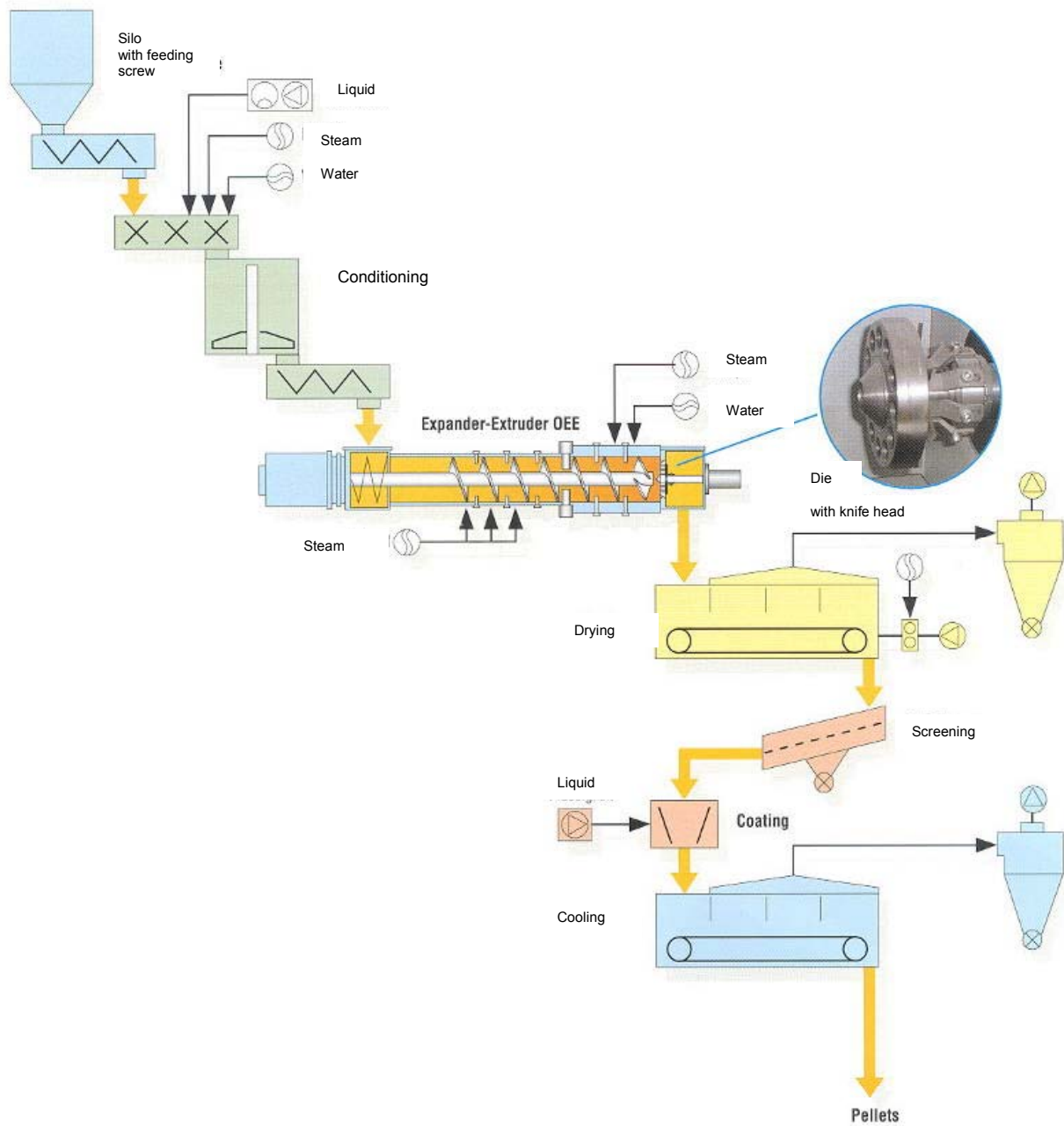


Fig. 3 Die with knife head

2.2 Plant design

- Existing plants
 - The extruder can be integrated into existing plants without any problems (especially if Kahl expanders are available).
- New plant
 - Fig.4: Example of a new plant

Fig.4 Diagram of a petfood line with expander/extruder OEE



3 Process parameters

The product quality (starch gelatinization, product form) can be essentially influenced by the following process parameters.

- 3.1 Grinding degree of the raw material
- 3.2 Conditioning
- 3.3 Selection of additives (e.g. oil, fat)
- 3.4 Mechanical energy input
- 3.5 Die geometry

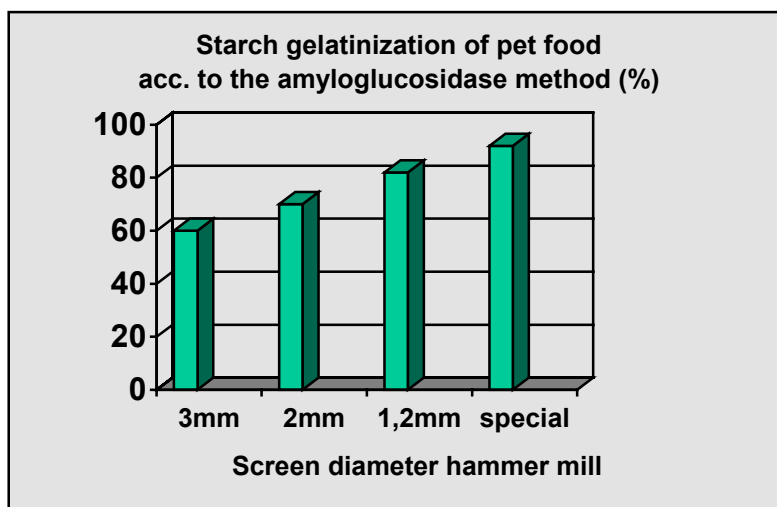
3.1 Grinding degree of the raw material

Special importance has to be attached to the grinding degree. All particles should be < 0.6 mm. The grinding degree decisively influences the starch gelatinization in case of identical extrusion parameters, as is shown in fig. 5.

Furthermore, the grinding fineness is a prerequisite of a smooth pellet surface.

If a hammer mill is used for grinding, the diameter of the screen perforation should be 1.2 mm or - even better - 1.0 mm. Anyway a resifting device following the mill is required. The use of wheat meal is better than the use of wheat, as wheat meal already has a fineness of < 0.3 mm.

Fig. 5 Starch gelatinization in dependence on the grinding degree



3.2 Conditioning

Due to the pre-conditioning of the product (10-minutes-conditioner) the product waste produced during the starting phase is minimized.

Pre-conditioning allows both a lower energy input into the extruder and a shorter extruder design.

3.3 Selection of additives (e.g. oil, fat)

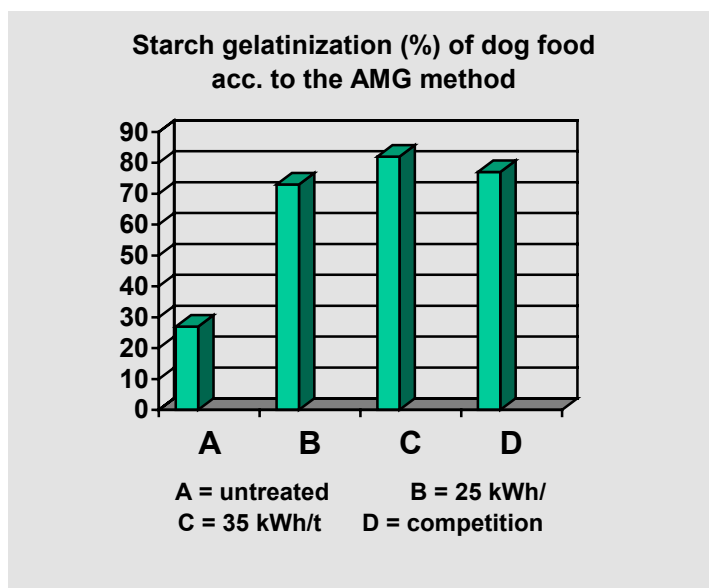
Fat (up to 3 %) is added prior to the extruder.

Up to 15 % of oil is sprayed on between drier and cooler (better penetration).

3.4 Mechanical energy input

The starch gelatinization and thus the product quality can be influenced by means of the energy input.

Fig.6 Starch gelatinization in dependence on the energy input.



3.5 Die geometry

A variety of shapes of the extruded product can be achieved depending on the geometry of the bores.

Fig. 7 Die for dog food with exchangeable hole inserts.

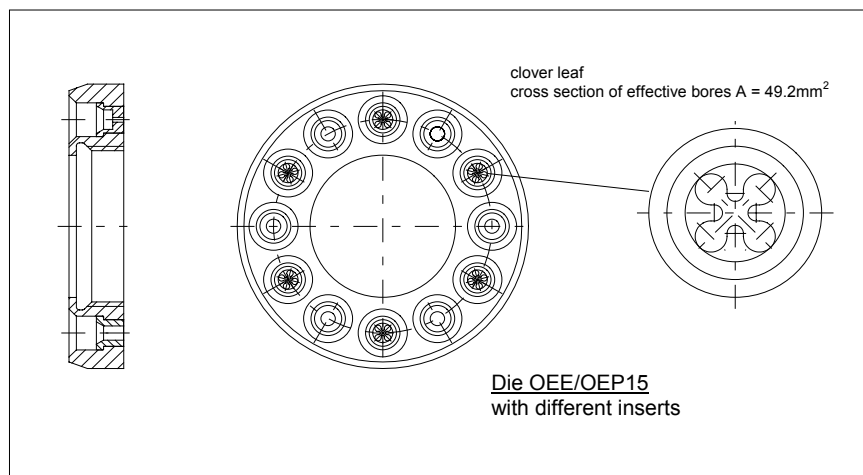


Fig. 8 Selection of different product shapes



4 Conclusion

The Kahl expanders/extruders are multi-purpose machines in the petfood industry. The product quality depends on

- grinding
- conditioning
- the formula
- mechanical energy input
- die geometry

Different pellet shapes can be chosen such as

- round pellets
- cloverleaf shaped pellets
- annular pellets
- bones

The flexibility can be increased by means of additionally installing an annular gap outlet so that extruded petfood, extruded fishfeed, or extruded/crumbled product for poultry or pigs can be optionally produced.