## ENERGY CONSUMPTION OF THE CRUMBLING PROCESS

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**Summary.** The paper presented a study on the energy consumption of crumbling process at different parameters. Raw material was disintegrated to the size less then 1 mm and pelleted on the pelletizer GR-2 with the hole diameter of 4,8 mm in the die. The obtained pellets were crumbled at the gap of 1,5 mm between rolls and at three different rolls speeds: 300, 500 and 700 r.p.m. The effect of the rolls speed increases is the rise in the processing efficiency and the decrease of the energy consumption per 1 ton of product.

Key words: energy consumption, efficiency, crumbling process

### INTRODUCTION

Pressing agglomeration involves four different processes, i.e.: pelleting, briquetting, expanding and extrusion [Grochowicz 1996, 1998, Zawiślak 1997]. The predominant process of pressing agglomeration is pelleting. The process of pressing agglomeration is high energy -consuming. The main source of the energy consumption is a pelletizer. Energy consumption of pelleting depends on the kinds of feed mixtures, physical properties of components, technical and technological process parameters and method of realization. Efficiency and energy consumption of the installation depends also on the hole diameters in the die [Opielak 1997, Romański 1999].

The effect of the hole diameters rise is the decrease of the energy consumption, density and kinetic resistance of the pellets.

The crumbling process is the cause of energy consumption decrease and efficiency rise in the chicken feed line production. This process takes places after cooling.

The main elements of the crumbler apparatus are: two rollers and a power unit containing engine and two gears (Fig. 2).



Fig. 1. Scheme of pelleting process in the feed production line

Sub-assembles and the rolls bearings are fixed into the frame. All of its elements are tightly closed into the box to protect the people contact with rotating elements. A crumbled pellet is fed between the rotating rolls at different speeds and directions (Fig. 3).

An amount of crumbled pellets depends on the gap between rolls. Gap control is possible at a special hand-wheel or engine staking from dispatch office.

A driving roll rotates with a higher angular speed then a stretch roll. Adequate belt tension of the gear is maintained by stretch wheel fixed into the frame with the possibility of the gap regulation.

A driving roll is automatically moved by overload springs fixed into the mechanism regulation of the distance between rolls axis at the time of machine overload or unequal pellet feeding.

Maximum efficiency reaches depend on the relation between pellet size and roll diameter. If the pellet diameter is large then the crumbling process produces an excessive amount of dust fraction at small efficiency. According to American Standards if the rolls diameter is 6 inch (15.2 cm) then the pellet diameter should not exceed more then 1/4 inch (0.635 mm). Pellets should continue feeding the crumbling zone and uniformly passing on the whole length of the rolls. The efficiency of the machines rapidly exceeds 10 t/h and it is correlated with the gap size between rolls.



Fig. 2. Crumbler construction: 1 – driving roll, 2 – stretch roll, 3 – engine, 4 – toothed gear,
5 – belt transmission, 6 – frame, 7 – support, 8 –regulation of distance between rolls, 9 – stretch wheel of belt transmission, 10 – overload springs



Fig. 3. Scheme of pellet crumbling

According to the American Standard: rolls diameter is 12 inch (30,5 cm) and 72 inch (183 cm) length.

The engine power of a crumbler is between 4 and 5 kW and 18–20 kW at double section units. After cooling the crumbler is placed on the process line for dust fraction reduction.



Fig. 4. A stand for energy consumption measurement during the crumbling process

## MATERIALS AND METHODS

Study on the energy consumption of the crumbling process was conducted on two different mixtures. Raw material was disintegrated to the size less then 1 mm. All materials were screened at the size of the hole diameter of 1 mm.

Mixtures were pelleted on the pelletizer GR-2 with the hole diameter of 4,8 mm in the die (Fig. 5). the obtained pellets were crumbled at the gap of 1,5 mm between rolls and three different speed rolls: 300, 500 and 700 r.p.m. All the measurements were conducted in 5 repetitions, and the results of the average value was demonstrated in the figures.

### RESULTS

The obtained pellets from all the mixtures were characterized by high kinetic resistance of 95%.

The high value of this index indicates a correct agglomeration process. Results conducted with crumbling process are presented in the Fig. 5, 6, 7 and 8. Rolls speed increases from 300 to 700 r.p.m. were the causes of efficiency rise at two mixtures, Fig. 5. The effect of high roll speed is energy consumption decreasing during crumbling. The highest difference in energy consumption was observed between roll speed of 300 and 500 r.p.m., Fig. 6.



Fig. 5. The efficiency of the crumbling process dependent on the rolls speed



Fig. 6. Energy consumption of the crumbling process dependent on the rolls speed



Fig. 7. Amount of proper crumbled friction dependant on the roll speed

During a further increase of a speed roll the decrease of energy consumption is less significant than at the start. But the speed roll increase is affected by dust friction (less then 0.5 mm) rise, and it must be again agglomerated.

The amount of dust friction is 8-9% at the speed roll of 300 r.p.m. and it rises to 17-20% at the speed roll of 700 r.p.m.

The effect of double pelleting is the rise of energy consumption and decrease of the processing line efficiency.



Fig. 8. Energy consumption of double pelleting with fraction less then 0,5 mm

### CONCLUSIONS

1. The effect of the rolls speed increases is the rise in the processing efficiency and decrease of the energy consumption per 1 ton of product.

2. Crumbling at the high rolls speed is affected by dust friction production. Double pelleting of its fraction increases the energy consumption of the whole feed process production.

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