Leveraging surfactant-based milling aids in preconditioning process to enhance pellet milling efficiency, feed quality and feed mill profitability

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1. Introduction

Keeping cost low is a fundamental objective to ensure the profitability and viability of any business. Many feed millers place their focus on reducing the raw material costs to secure their profitability as it is the largest cost in the feed production. However, there is an additional way where feed millers can significantly reduce their feed cost and that is improving the milling processes.

2. Challenges in Pellet Milling

Pelleting is often the limiting factor that affects the production yield of pellet milling. One of the common aspects that reduces the pelleting efficiency is when the mash feed is neither at its optimum moisture level nor the optimum condition for efficient pellet milling. The inadequate moisture in the mash feed increases the friction during pelleting which results in higher energy consumption and slower throughput.

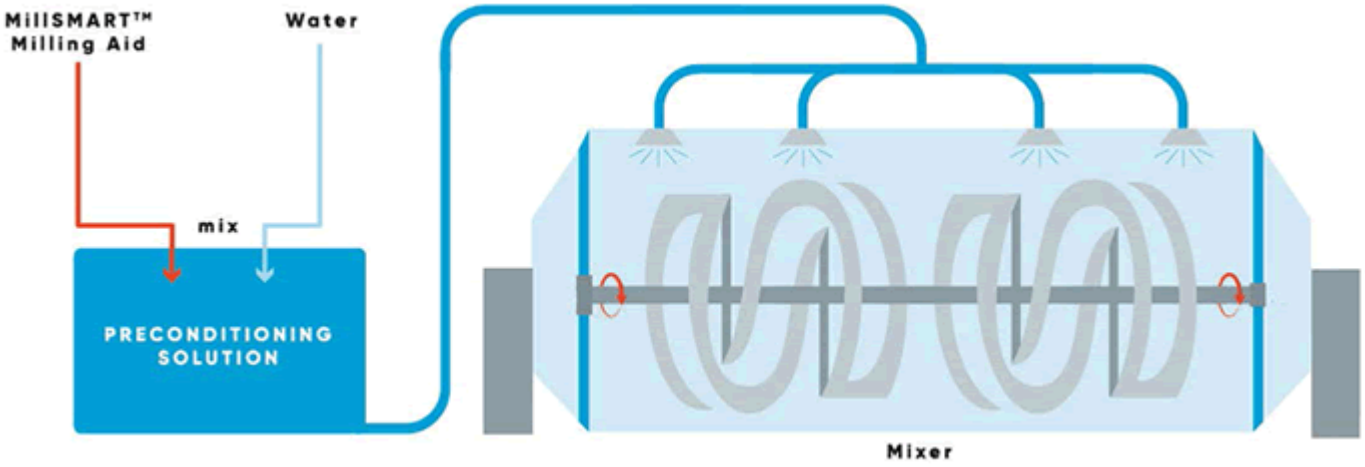
There are two key reasons why the mash feed is not always at its optimum level. The first reason is that during the grinding process, heat is generated and a moisture loss of 0.5% to 1.0% from the feed ingredient is commonly observed (practical experience). Secondly, the variability in the moisture of raw feed materials from batch to batch can also result in the mash feed not at the optimum moisture level all times.

Insufficient moisture in the mash feed can also adversely impact the pellet feed digestibility and durability. Moisture and heat are two critical elements for starch gelatinization to occur during conditioning. Starch gelatinization improves feed digestibility by making the starches more accessible to the digestive enzymes in the animals' body1. The sticky texture of gelatinized starches also helps the feed particles adhere together to form durable pellets2. Inadequate moisture discourages starch gelatinization and thereby limits the feed digestibility and durability.

3. Preconditioning Mash Feed

Preconditioning the mash feed ensures its moisture is at the optimum level prior to conditioning and pelleting. The preconditioning process is executed in the mixer after dry mixing. During this process, a preconditioning solution is prepared by mixing the milling aid containing surfactants with the water. This solution is then added into the mixer to precondition the mash feed (Figure 1).

Figure 1. Schematic diagram showing how the preconditioning process is carried out.



4. Use of Surfactants in Preconditioning

Surfactants are compounds that can reduce the surface tension between two liquids or a liquid and a solid3. Adding surfactant-based milling aid into water helps to potentiate the preconditioning process. Preconditioning the mash feed with water alone is not effective, as water by its own has a very high surface tension (~72 nM/m, 25°C)4 which prevents moisture from being absorbed effectively into the feed particles (Figure 2).

When surfactants are added into the water, they decrease the water surface tension and improve moisture absorption into feed. Better moisture retention in the feed particles facilitates starch gelatinization during conditioning, which improves the digestibility and durability of the pellet feed. Improved moisture retention also helps to minimize the feed shrinkage during the cooling process (Figure 3).

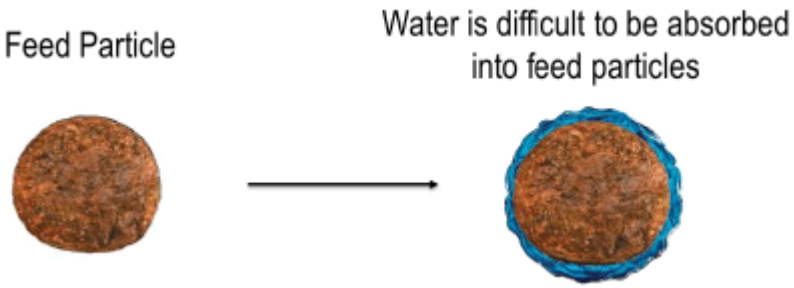


Figure 2. Cross-sectional schematic diagram showing the high surface tension of water prevents it from being absorbed effectively into the feed particles.

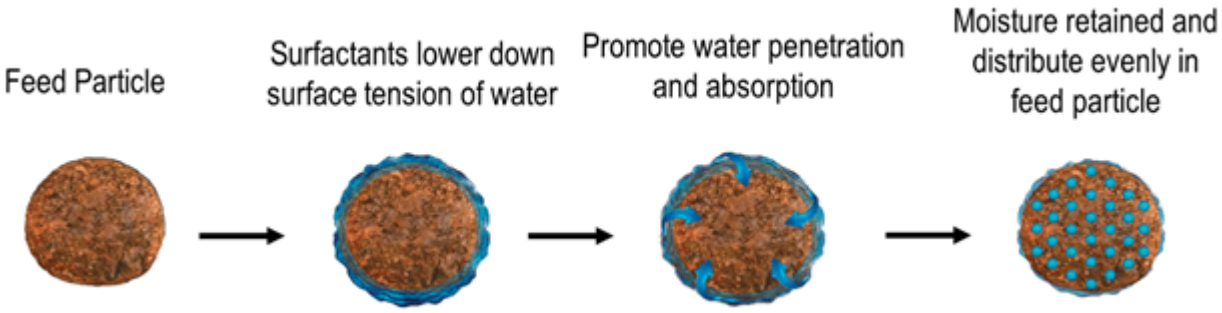


Figure 3. Cross-sectional schematic diagram showing how surfactants improve moisture absorption and retention in the feed.

Another purpose of adding surfactant is to enhance the spreading of the preconditioning solution such that it can be

distributed evenly throughout the feed5. This helps to smoothen the pelleting process by lubricating the feed, allowing pellet milling runs at higher efficiency.

5. Feed Milling Trial

A feed milling trial was conducted at a feed mill in South East Asia, on sinking fish pellet feed to evaluate the effectiveness of preconditioning the feed with moisture mixed with surfactant-based milling aid, KEM WET™ LR Liquid6. Parameters on milling efficiency, feed moisture, and feed mill profitability were evaluated.

There were two groups in this study:

Control (C) – feed without added moisture and surfactant.

Treatment (T) – feed added with 1.5 % preconditioning solution prepared by mixing water with KEM WET™ LR Liquid.

In this study, the conditioner temperature was set between 84 °C to 85 °C, with a total of 12 MT of feed for each group.

5.1 Improved Feed Mill Performance and Feed Moisture

Improvement on milling efficiency was observed when the mash feed was preconditioned with preconditioning solution containing surfactants (T) (Figure 4 and 5). The pellet mill energy consumption was reduced by 13% and throughput was enhanced 16%.

The finished feed moisture in treatment increased by 1.02%, from 9.44% to 10.46%, equivalent to 68% retention of the added preconditioning solution. The surfactant in KEM WET™ LR Liquid reduced the surface tension of water effectively, enabling the moisture to be better absorbed and retained in the feed particles, hence minimizing moisture loss during the cooling process.

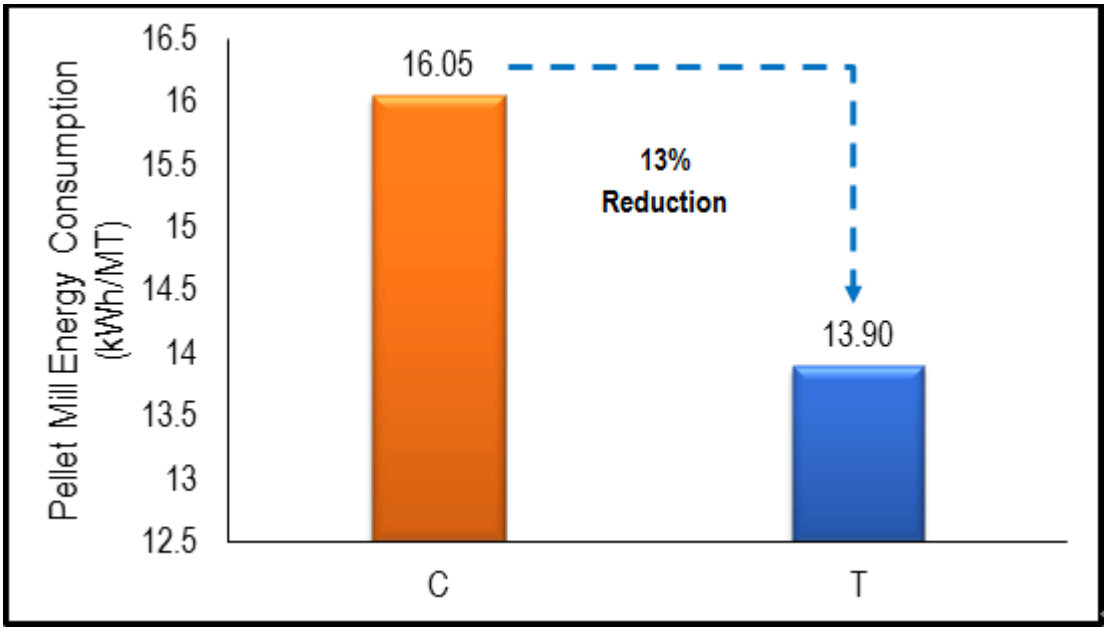


Figure 4. Energy consumption in pellet press of control and treatment.

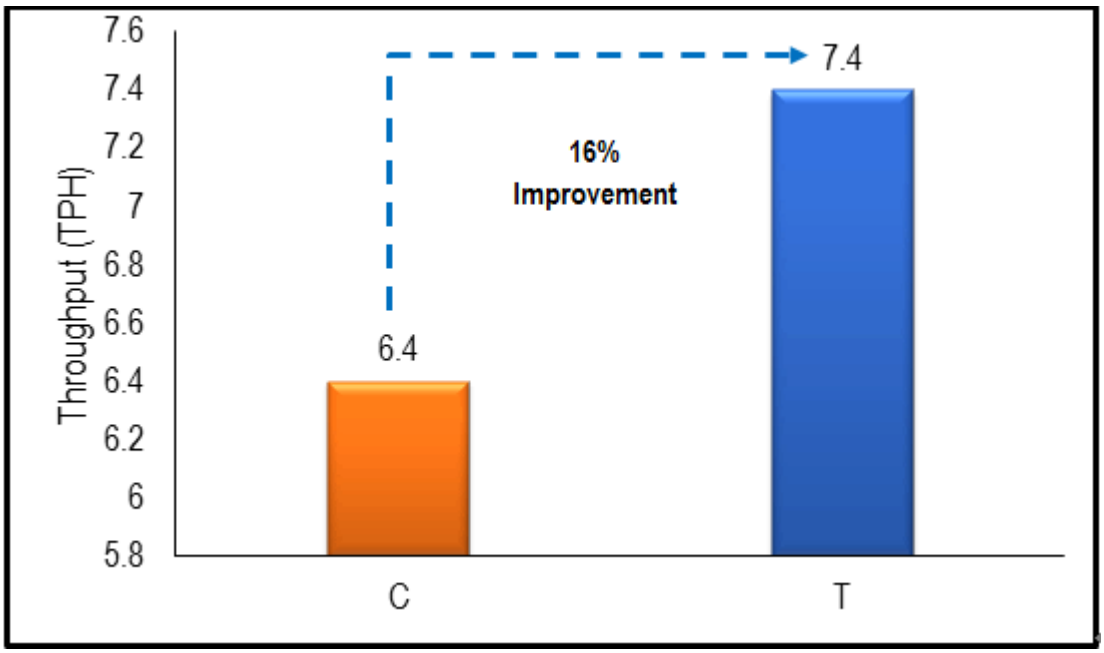


Figure 5. Feed throughput of control and treatment.

Table 1. Feed moisture content of each group after mixing, pelleting, and bagging.

	Feed moisture content (%)	
	C	T
After Mixing	10.53	11.90
After Pelleting	11.12	11.86
After Bagging, Finished Feed	9.44	10.46

5.2 Financial Benefits of Preconditioning

Preconditioning the mash feed with moisture and KEM WET™ LR Liquid (T) offers a huge cost saving to the feed miller. The feed miller saved USD 3.56 for every MT of feed produced (Table 2). The cost savings are calculated based on the feed price, milling aid inclusion cost, electricity and production costs and the feed mill's production capacity.

6. Summary

Preconditioning the mash feed to bring the mash feed moisture to optimum level prior to conditioning and pelleting is an effective approach to improve milling efficiency. The use of surfactant-based milling aid reduces water surface tension and it helps to improve the moisture absorption and retention in feed particles. This also enhances the spreading of preconditioning solution throughout the feed for smoother pellet milling.

The trial results showed preconditioning the mash feed enhanced the milling efficiency andallowed the feed miller to improve its profitability by bringing down the feed manufacturing cost.

References

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