

Research on a novel water-saving cleaning technology for wheat

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Abstract. Wheat washing can remove stone, dampen and clean. It works with the help of water solubility and flushing action to purify the surface of wheat. For the water consumption and pollution of traditional wheat washing machines have become increasingly prominent, a water-saving cleaning technology for wheat based on rough-fine washing separation was presented and studied. In this paper, the principle on rough-fine washing separation is first shown, and a realization solution based on rough-fine washing separation was developed. For verifying the effect on rough-fine washing separation, comparative experiments were done. After wheat was sent into the washing machines, rough-washing and fine-washing were completed. Compared with the traditional wheat wet washing technology, the measurement value about cleaning effect is not reduced. With the help of water-cycling system, the effective reuse for water is achieved, and water-saving is about 2/3. The pollution to environment is reduced radically, and the production cost of enterprises is significantly reduced.

Introduction

In the growth, harvesting, drying, transport and storage of wheat, wheat would produce a certain amount of mildew grain, wormhole grain, germination of grain, pesticide residue pollution grain, etc. And this seriously affects the quality of grain [1][2][3][4]. Therefore, in milling, wheat cleaning before grinding has a great influence on whiteness, purity, ash and other important indicators of flour. However, the study of wheat cleaning was mainly concentrated in the harvester and seed [2][5][6][7]. The studies present a reference for cleaning the wheat to mill.

Now, the wheat cleaning technology mainly includes the dry cleaning and wet cleaning. Dry cleaning is mainly used in the large flour milling enterprises for small water consumption and small pollution[8][9]. While, the dry cleaning has a poor cleaning effect on the surface dust, microorganism, eggs, insect pest and disease wheat, sediment and coal cinder embedded in the abdomen ditch, et al. So, it is difficult to produce the high quality flour. Wet cleaning can clean the dust on wheat surface, erase part of the epidermal wheat in the drying process, bleach out no edible value shriveled wheat, removal of the diseases wheat and pesticide residue is more than 80%, and has functions of removing stone and dampening[10][11]. As the improvement of flour quality requirements, the flour processing enterprises newly built especially the small and medium enterprises re enable the wheat washing machines and wet cleaning technology based on wheat washing machines.

However, with the improvement of environmental protection requirements for enterprises, the water consumption and pollution of traditional wheat washing machines have become increasingly prominent, and seriously affect the benefit and survival of flour processing enterprises. Therefore, in recent years, people begin to study on the wheat cleaning water-saving technologies and equipments [12][13], such as the layered peeling cleaning and milling for wheat, the reusing and cycling system of waste water for wheat cleaning based on photoelectric detection and control, et al. Because the profits of flour enterprises are meager and unable to use the recycled water treatments to reduce the consumption of water resources, the practical water-saving wheat washing technology and equipment of low cost are an urgent need for research and development.

In this paper, water-saving cleaning technology and its application for wheat based on rough-fine washing separation were studied. With the help of grading cleaning technology and water-cycling system, the effective reuse for water was achieved. Compared with the traditional wheat wet washing technology, water-saving is about 2/3. The pollution to environment is reduced fundamentally, and the production cost of enterprises is radically reduced.

Principle on rough-fine washing separation

"Wheat washing" can remove stone, dampen and clean. It works by the water solubility and flushing action to purify the surface of wheat. And it separates stones, kernels and other harmful impurities from wheat through proportion, size, shape and settling velocity between wheat and sand. After water washing, mildew, thermal, pesticide residues can be effectively removed. And dust, sand and microorganism in the wheat abdominal are cleaned. The ash content and sand content are further reduced and the flour whiteness is improved. In rough-fine washing, wheat is sent to wheat washing machines to be cleaned 2 times and the cleaning process completed in a cleaning is changed, so the good cleaning effect is realized. In cleaning, the effective reuse for water is achieved with the help of water-cycling system, and water-saving is realized. The wheat washing process is shown in Fig.1.

Wheat is first sent into the rough-washing machine to preliminary abandon sand and miscellaneous. And then, wheat is sent into the fine-washing machine where the residual sand and miscellaneous are cleaned, fine-washing is implemented. The fine residues are removed under the direct cleaning by fresh water. In processing, water drained after rough-washing contains more impurities and dirt, and then is directly discharged as wastewater. After fine-washing, wheat is sent into the next procedure. Meanwhile, water discharged after fine-washing almost is not polluted and can be applied to rough-washing.

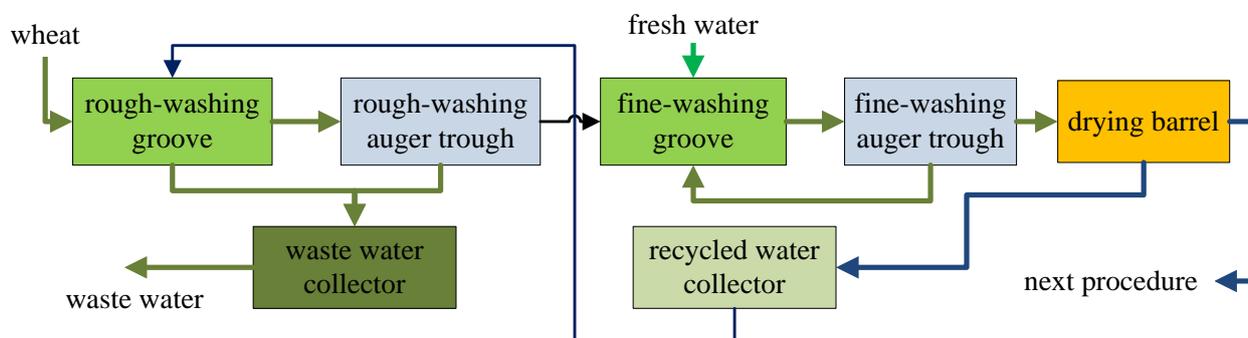


Fig.1 Principle on grading cleaning

Materials and instrument

In order to have an objective comparison, the experiments were implemented in workshop rather than laboratory.

Wheat samples Wheat in experiments was from Nan Yang, Henan province in south central China, which was the mixture of the soft white wheat and hard red wheat. The amount is 2 ton, and the soft white wheat was about 60%. In order to have an accurate comparison, the wheat in experiments was divided into 2 parts after mixed evenly. One part was used to complete the traditional wheat wet cleaning experiment, the other was used to experiment the rough-fine washing.

Water Experimental water was directly from the deep natural groundwater. There was no chemicals added in the water.

Instrument The wheat flour was milled by the industrial steel grinding. Ash detection was by Fluoroscan F2000 made in British Branscan. Whiteness detection was by DN-B whiteness meter made in Hangzhou Dacheng Optoelectronic devices of china. Moisture detection was done according

to GB/T 24898-2010 of China, and SH-8B(near infrared measuring instrument) made in Shanghai of China was used. Bacteria, ash and whiteness detection were done according to GB1355 of china.

Experiment study

Rough-fine washing to wheat changed the movement route of wheat flow in cleaning. After wheat was fed into the washing machine, rough-washing and fine-washing were completed, and fine-washing was separated from rough-washing. So, it had a good effect for the longer cleaning time and route. For verifying the effect on rough-fine washing, we carried out the experiments. In these experiments, the principle based on rough-fine washing separation was taken as shown in Fig.1. In order to compare the cleaning effect, the ash reduction value for wheat to mill was measured 3 times. 1#flour was selected as the test sample, it's key indicators such as ash, whiteness were also measured 3 times. The experimental results are as shown in Fig.2, Fig.3 and Fig.4.

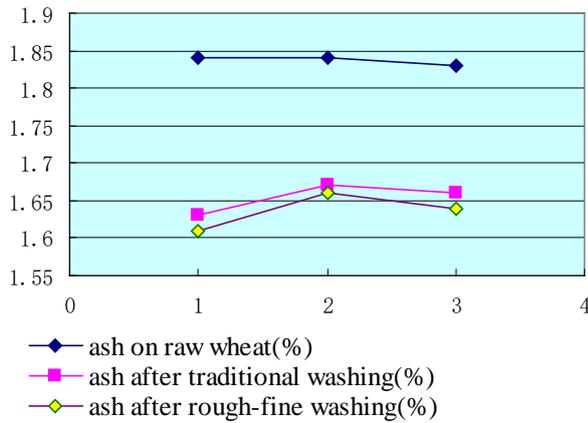


Fig.2 Ash value measurement for wheat to mill

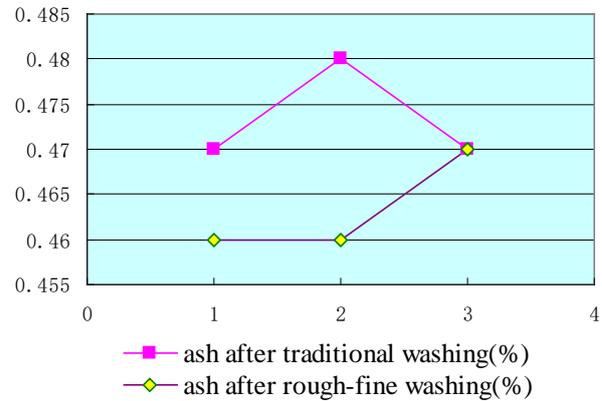


Fig.3 Ash measurement for 1#flour

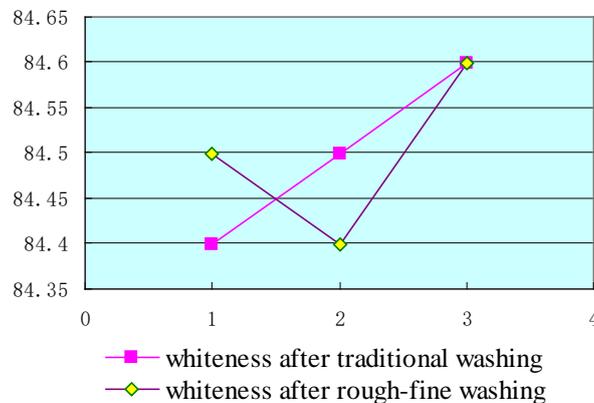


Fig.4 Whiteness measurement for 1#flour

In rough-fine washing, the fresh water was directly pumped into the fine-washing machines. The recycled water thrown out in drying was pumped into the rough-washing machine groove to be reused. Therefore, water consumption is only 1/3 of traditional wheat washing machines, and the water-saving effect is obvious. The rest indexes are shown as follows:

(1) Compared to the traditional wheat washing, ash value is reduced 0.1-0.2% for the wheat to mill. This shows that the rough-fine washing does not reduce the cleaning quality of wheat to mill with reducing the amount of water.

(2) Compared to the traditional wheat washing, ash value is reduced 0.1-0.2% for 1#flour.

(3) Compared to the traditional wheat washing, whiteness value is not improved for 1#flour and maintained at the same level.

Conclusions

For water consumption and pollution of traditional wheat washing machines have become increasingly prominent, the water-saving cleaning technology based on rough-fine washing separation was studied. Under the current wet cleaning process and existing equipments, the movement route of wheat flow into washing machines is changed and the cleaning time is longer. After wheat is sent into washing machines, rough-washing and fine-washing are completed. Compared with the traditional wheat wet washing technology, the measurement value about cleaning effect is not reduced. With the water-cycling system, the effective reuse for water is achieved and water-saving is about 2/3. The pollution to environment is reduced fundamentally, and the production cost of enterprises is significantly reduced.

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