Liquid Coating Techniques of Animal Feeds

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Delivered by

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Good morning, ladies and Gentlemen

First of all, I am very happy to be introduced by Chairman Dr. Yutong Huang

It is my great pleasure to have the opportunity to present my paper under the title, "Liquid Coating Techniques of Animal Feed" here this morning.

This title has been slightly changed from the original one, but the contents of my presentation remain almost the same.

I think, it is truly my personal honor and pleasure to have been invited to this important conference as a Keynote Speaker.

In this regard, I would like to express my sincere gratitude to APCAEM and the Organizing Committee for making this wonderful and significant conference happen under the theme, "International Seminar and Exhibition on Animal Feed Biotechnology" which, I think, is one of the most important and vital issues for all of us today.

My presentation today will, first of all, concentrate on the necessity of liquid coating for animal feed

And then, I would like to briefly introduce a kind of coating system developed by Poultry & Livestock Equipment Research Institute, Chinese Academy of Agricultural Mechanization Sciences

After that I would like to say something about current status and future of liquid coating

Now, I will start my talk with the necessity of liquid coating for animal feed.

1.Necessity of liquid coating

The use of liquid ingredients in animal feed production is increasing dramatically as an ever increasing range of products becomes available. The most common types of liquid ingredients used in animal feed production today are fats, vitamins, minerals, antibiotics, amino acids and enzymes. Of these ingredients the group of products which has probably created greatest interest in the industry in recent years is enzymes. In terms of animal feeds which are predominantly composed of cereals and vegetable proteins, a large portion of these ingredients can not be fully digested by mono-gastric animals. Much of the energy available is locked up in the form of non-starch poly-saccharides (NSP) that mono-gastric animials are unable to digest. Similarly most plant materials used in animal feeds contain the mineral phosphorus which is bound in the form of phytic acid and can not be degraded by mono-gastric animals. External enzymes added directly to feeds act as supplements to the normal digestive enzymes already found in the animal's digestive system. The idea of using enzyme supplements is to increase digestibility, facilitating better utilization of feeds. The greater the utilization of the feed the better the animal performance and the lesser the load on the environment in terms of manure or waste. In short, the use of micro-ingredients such as vitamins, minerals, amino acids, antibiotics and enzymes and their variability to the animal feed in exact amounts is playing an increasingly important role in

efficient animal production, not only from an economic point of view but also from an environmental point of view.

The problem facing the feed manufacturer, the producers of the ingredients and manufacturers of processing equipment is that many of these vital ingredients whether added as supplements or naturally present in raw materials are thermally unstable during processing conditions used in the feed mill today. In fact the trend today is towards the use of high temperature processing techniques utilizing expanders and extruders which enable temperatures in excess of 100℃ to be achieved. Typical processing temperatures in today's feedmill utilizing expander technology are shown graphically in Fig.1. Slide 2

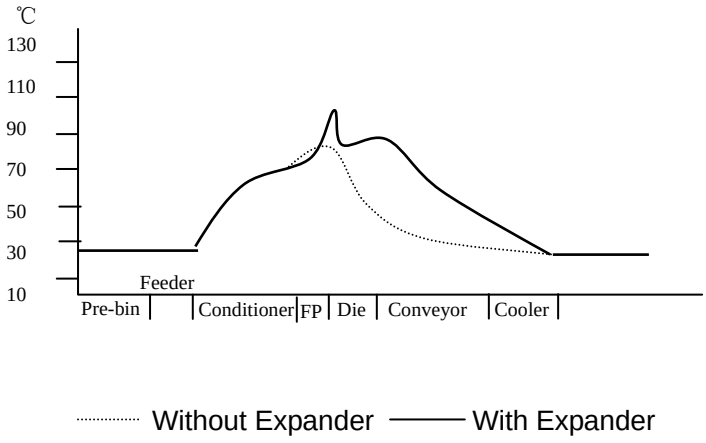


Fig.1 Feed temperature in typical expanding process

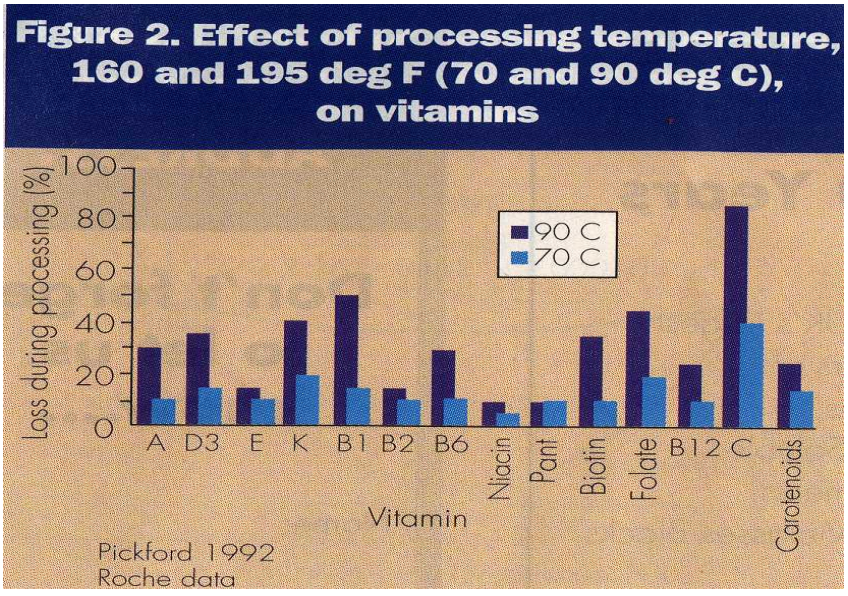
Here is an example for the effect of today's processing temperatures on one of the more heat sensitive enzymes phytase, which is responsible for the release of phosphorus from phytic acid. The degradation of phytase in barley/wheat-based pig feed rations at various processing temperatures

is shown in Table.1. Slide 3

Table.1. Effect of processing temperature on phytase activity in a barley/wheat-based pig feed ration.

Process Stage	Temperature	"Relative" Phytase Activity
Before conditioner	27.9℃	100
After conditioner	80.5℃	76
After pellet press	70℃	47
After expander	102℃	18
After expander+press	79℃	12

Based on a research result from Roche, high temperature processing also causes big losses on Vitamins (See Fig.2). Slide 4



There is no need to mention the advantages of high temperature processing, such as reduction of salmonella and other bacteria, improved animal performance, improved pellet quality and low cost formulating. However for the manufacturers of micro-ingredient supplements, there is a

long way in producing products capable of withstanding these desired temperatures without added expense to the feed manufacturer. Still, in most instances overdosing to compensate for thermal losses and a reduction in the range of materials available are the only 2 choices for feedmills.

In addition, for many years, fats and oils have been used in the formulation of rations for animals as a means of increasing the energy density since fats have 2.5 to 3 times the average energy of cereals. However, there are restrictions in the quantities of fat which can be included in a ration, for practically more than 3 % of fat addition could result in poor pellet quality.

For all these, many different processing systems have been developed. But basically this is a system whereby liquid ingredients are sprayed on to the finished product after the cooler. And a large number of feed mills are already doing this today.

2. LC50S Liquid Coating System

The following is an introduction about the liquid coating system LC50S developed by Chinese Academy of Agricultural Mechanization Sciences. Having been put into the market since last year, the system has been installed in more than 10 domestic feedmills and they are all satisfying.

A. Working principle Slide 5 Slide 6

Fig.3 is the system configuration of LC50S. It is composed of control

panel , liquid coater, liquid metering system, liquid tank, liquid pump and feeder altogether 6 parts. During working, finished feed is delivered from the supply system to the surge bin which contains high, middle and low level indicators. The high level indicator is to control the upstream supply system in case of the system blockage. The low and middle level indicators control both the feed and liquid supply to the coater. When the feed mass falls below the low level indicator, both the pump and feeder turn off and the automatic valve closes, which results in a stop of feed and liquid supply to the coater. The feeder and the pump restart and the automatic valve opens automatically when the feed reaches the middle level indicator. After coated with liquid inside the coater the feed flows out from the outlet. Manual override switches allow for cleanout of the system. The speed of the pump and the feeder is controlled separately by two variable frequency drives which are signalled by a smart controller. Through the controller the operator can easily adjust the RPM of the pump and the feeder hence the percentage of liquid addition. The system capacity is between 10 – 50 TPH adjustable with a liquid addition capacity less than 12% of the mass feed. And the flow meter accuracy is 1%.

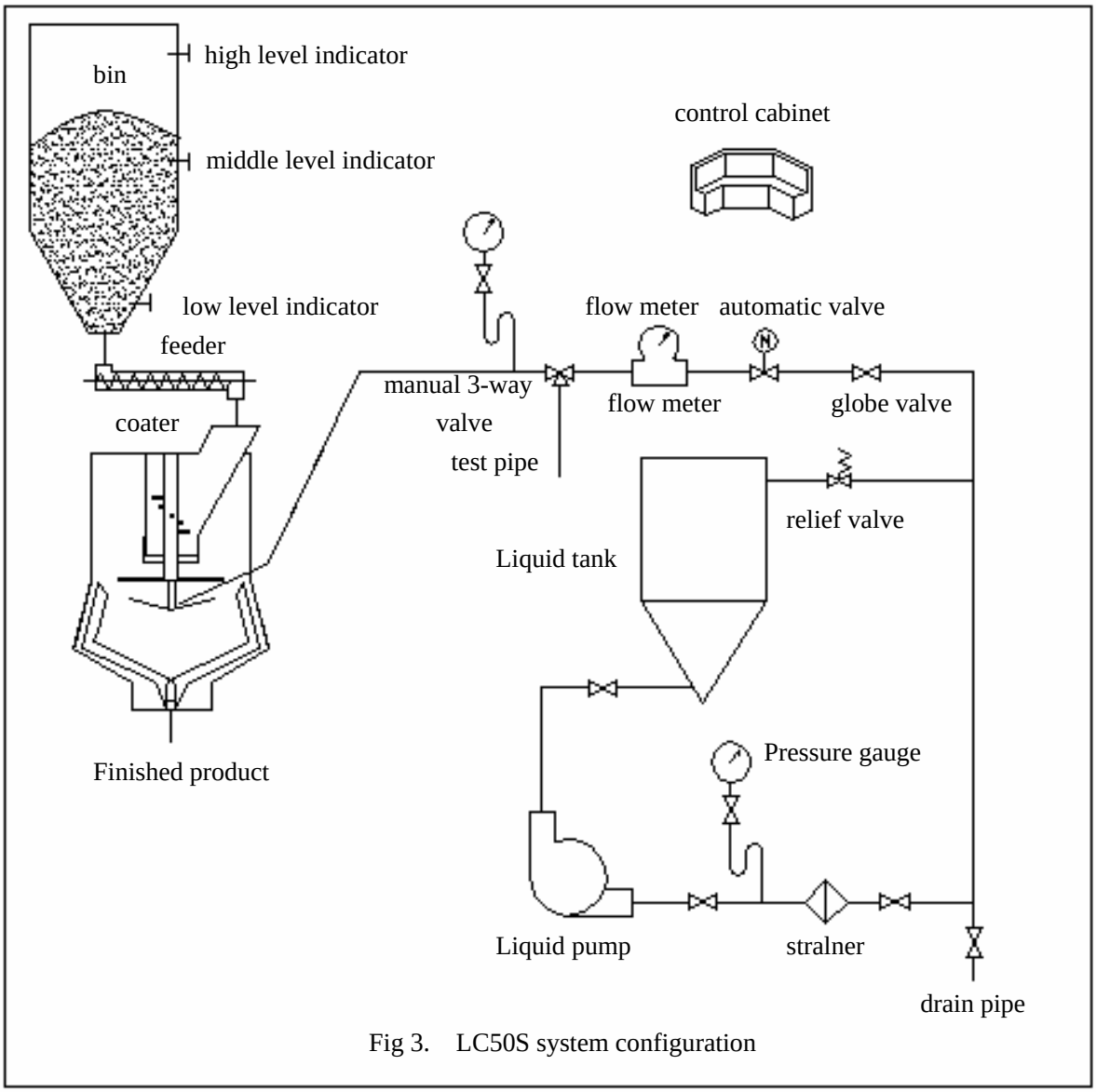


Fig 3. LC50S system configuration

Slide 7 Slide 8 Slide 9

Obviously coater is the vital equipment of the system (See Fig. 4). After starting, the feed stayed on the mass disk is cast by gravity and mass force forming a downward uniform curtain within 360 degrees. Meanwhile the liquid pumped into the liquid disk which is rotating at a high speed is thrown out forming an upward liquid cone composed of small droplets. The two opposite moving curtains contact each other within the coating chamber with the help of the paddles and then fall into the mixing chamber. After a

further mixing the coated feed flows out from the outlet.

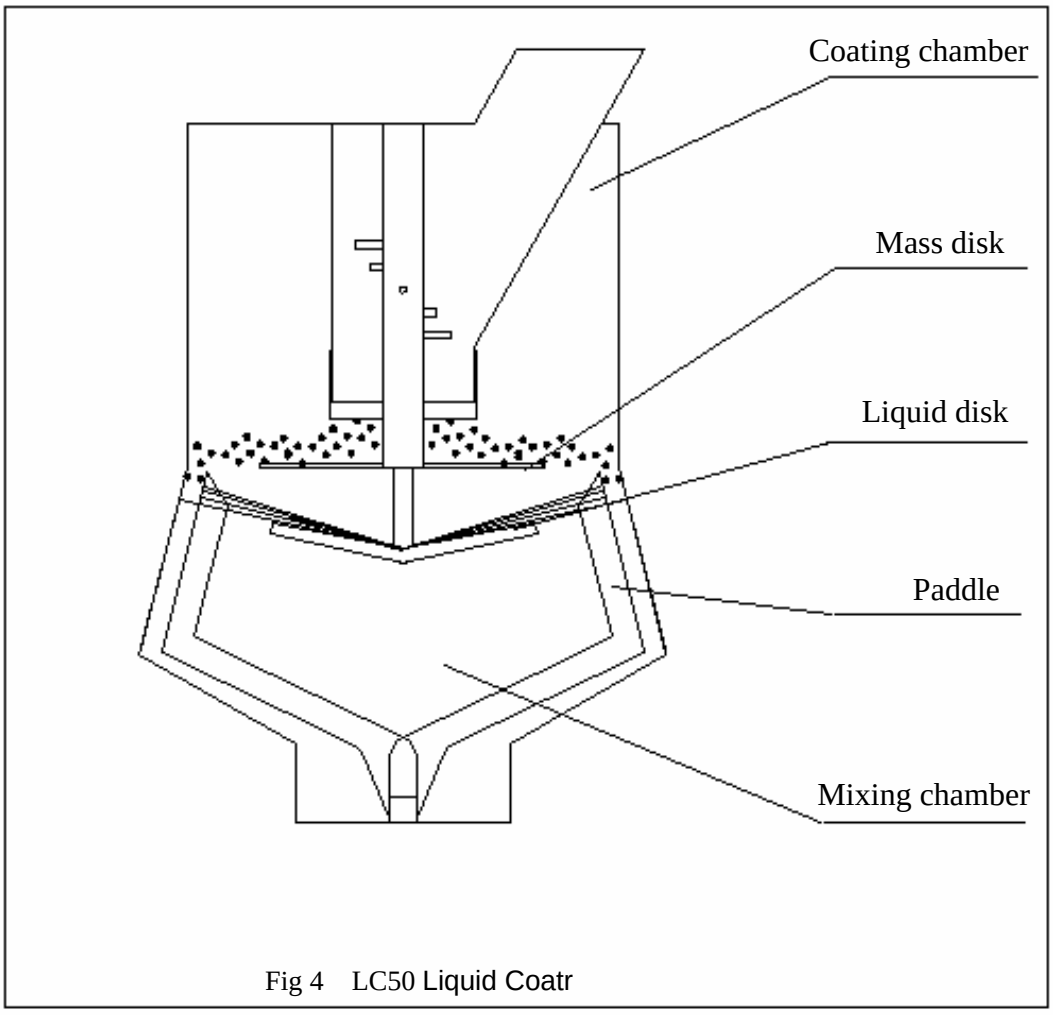


Fig 4 LC50 Liquid Coatr

B. Installation Slide 10

Fig .5 shows an installation of LC50S which can be described as on-line as it forms an integral part of the production line. Because the system has an adjustable capacity between 10 – 50 TPH and works on a principle of batch production, it can be installed in any feedmills with a capacity under 50 TPH.

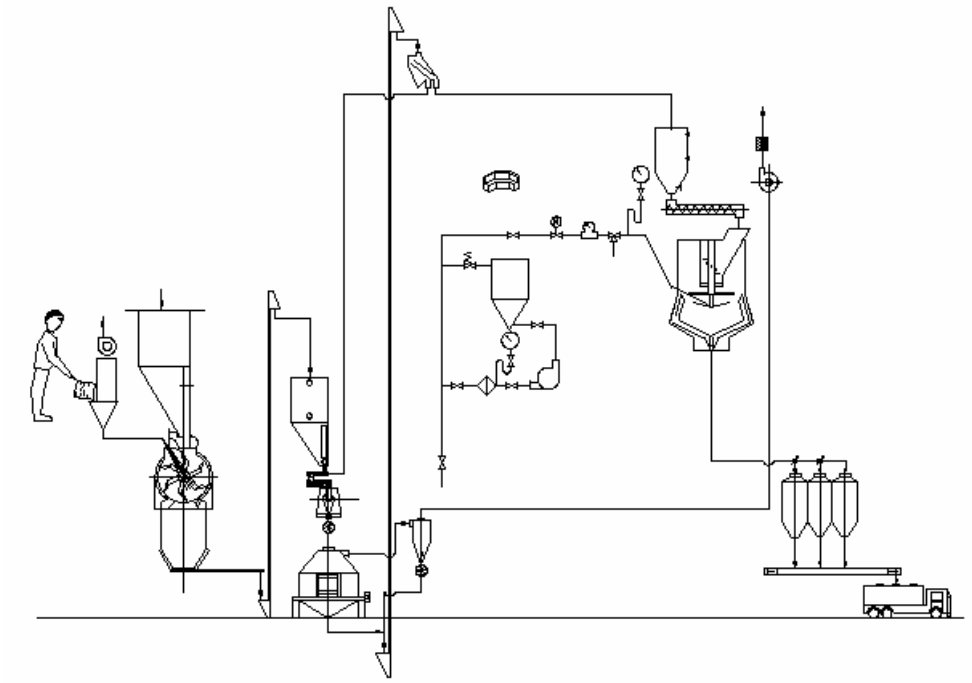


Fig 5. on-line coating system

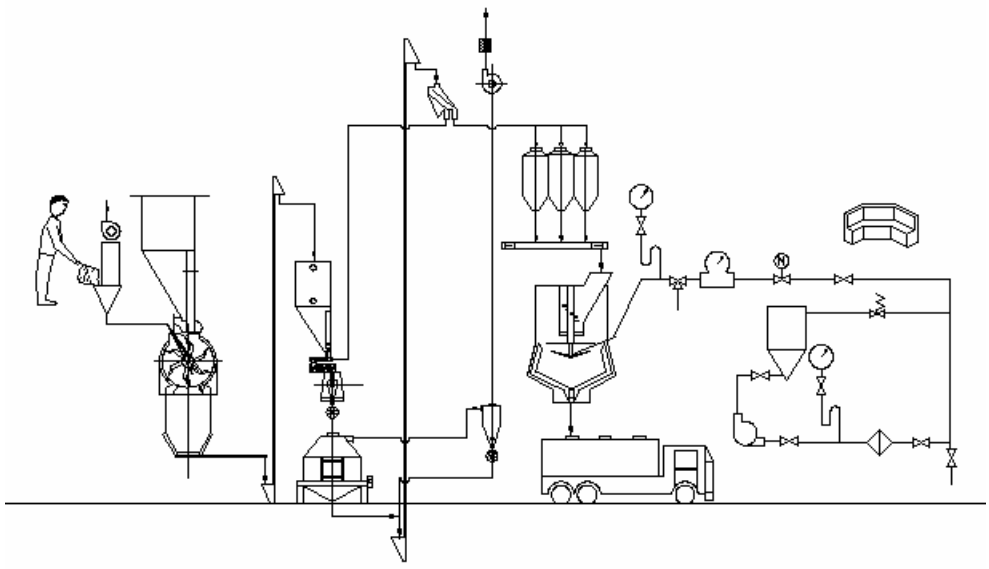


Fig 6. off-line coating system

Slide 11

Fig .6 shows an off-line system placed at the out-loading point. The advantage of this system is "Instant Sale after Coating" which makes fresh feed available. Furthermore it is possible to reduce the number of finished

product bins as a standard product can be transformed into a customer-specific product at the point of outloading. This in turn provides better production flexibility.

3.Current status and future of liquid coating

For liquid application, various technical principles and equipment are in development or already available. As a new technology, there are still many arguments on the issues such as carrier selection, reaction between ingredients, optimal droplet size distribution as well as proof of the sufficient operating accuracy. Take droplet size as an example. For homogenous distribution of the additives in the feed a high number of small droplets seems to be the best. But the mass of fine droplets is very low so that they follow more closely stream forces than mass forces. The consequence is the transport of the fine droplets with the air. Therefore optimization of the spray structure should not be neglected.

After all, the utilization of liquid ingredients in a post treatment process opens a lot of new doors to the feed manufacturer. This can be seen in the following aspects.

A. From an economic point of view there will be saving as the need for overdosing of micro-ingredients, some of which are quite expensive, will be eliminated. The range of micro-ingredient products available to the feed miller will be greater as the restraints of high temperature degradation are removed. Production flexibility will be increased as

basic formulations are converted to customer-specific ones in an offline coating system.

B. From an environmental point of view, micro-ingredients in liquid form are easier to handle. Many of the present micro-ingredients in powder form are hand dumped to avoid losses. Dust from these can be hazardous.

C. Cross contamination has always been a problem facing the feed manufacturer. For example, trace elements of some antibiotics used in pig feed formulations may not under any circumstances be found in chicken feeds and if the traditional micro weighing system, transport and mixing system is used this is almost impossible to avoid.

D. The design of future feed mills may also change as the use of liquid ingredients increases. Space requirements for micro weighing systems will be reduced. At the same time off-line coating systems, where basic formulations can be converted to customer-specific ones while outloading, will reduce the number of finished product bins. As liquid coating systems compared to micro weighing installations are considerably simpler and cheaper, i.e. in terms of transport, mixing, weighing equipment, bins etc, which are required for micro weighing, installation costs and capital investment will be reduced.

The use of liquid coating system in a post thermal treatment process whilst still a relatively mew concept to most is undoubtedly something we will be seeing a lot more of in the future.