Choline Chloride Production Line
Project Proposal

Shandong Tianli R&D Institute

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1. General

Choline chloride is an organic compound and usually grouped within the Vitamin B complex. As the main ingredient in acetylcholine, phosphatidylcholine and neuro-lecithin essentially needed by living creature’s body structure, choline chloride can adjust metabolism and conversion of fat in the body of a creature, preventing fat from settlement and cell denaturation in liver and promoting aminophenol re-formation and improving utilization of aminophenol as a carrier for methyl group. The laboratory test shows that choline chloride is especially important for chicken where it accelerates growth. The aminophenol and phosphatidylcholine both containing it are transmitted everywhere within chicken, effectively preventing fat from accumulating in livers and kidneys, accelerating their growth and raising their yield of eggs and hatching rate. Feeds lack in choline chloride will cause farmer animals to poorly grow, resulting in their rough hair, soft bones, poor health and slow growth. Hence, it is suggested that choline chloride be added to feeds in order to ensure farmer animals’ fast and healthy growth. Choline chloride can also be as an important accelerator and neutralizer for growth of plants and increase their yield by more than 20%. Besides, it can be employed as other additives or agents such as adjusting agent for growth of plants, agent for paper manufacture, catalyst, additive agent in texture industry and fuel oil drilling. With its more demand in market, choline chloride will have a promising future.

Choline chloride imports primarily generally overseas, it is used in the intensive processing. Countries in Western Europe's involve Holland, France, Belgium and so on, the farming resources are limited, the fine agriculture is primary, choline chloride takes the important plant production promoter and adjusts the composition, can make the fruits and melons grain to raise the output above 20%, therefore these countries use a great deal choline class green fertilizer. The US, Canada, Australia are the vast territory with a sparse population countries, the animal husbandry are very developed, the more widespread use choline chloride as feed additive. Since 2002, an American choline price has climbed, the market is quite stable. Southeast Asia’s Vietnam,
Burma, Laos, Cambodia, Indonesia and so on countries and South Asia's India, Pakistan, economical backwardness, the agriculture is primary, the population is large and grows quickly, the fish breeding and poultry raising developed in recent years is also more rapid, our country increased choline chloride’s export to these country's year by year, the market potential is very big.

Adhering to the design principle of “energy conservation and environment-friendliness”, Shandong Tianli R&D Institute continually strives for improvement in production line of choline chloride. After years’ research and development, we have made a great improvement in type selection, production capacity, process flow and automation control, achieving international advanced level in the same field because our newly developed production technique is featured by reliability, investment reduction, high return rate, energy conservation and etc. Now we would like to promote our products and transfer out patents, facing customers from foreign countries in order to make a little contribution for promoting this new generation of feed products.

2. Construction Conditions

2.1 Raw Materials

<table>
<thead>
<tr>
<th>Material name</th>
<th>Character</th>
<th>content</th>
<th>spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimethylamine</td>
<td>Colorless liquid</td>
<td>30%, 45%, 100%</td>
<td>Industrial product</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>Canary liquid</td>
<td>≥30%</td>
<td>Industrial product</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Colorless liquid</td>
<td>≥99%</td>
<td>Industrial product</td>
</tr>
<tr>
<td>70%, 75% choline liquid</td>
<td>Colorless or canary liquid</td>
<td>70%, 75%</td>
<td>Feed class</td>
</tr>
<tr>
<td>Corn core powder</td>
<td>Canary solid powder</td>
<td>30 items, moisture ≤ 13%</td>
<td>Feed class</td>
</tr>
</tbody>
</table>

2.2 Quality Assurance & Verification for Finished Products

The quality control shall adhere to HG2941-1999 standard.
2.3 Utilities

They consist of a 300KVA substation, 20ton/h industrial water and intra-circulation system, 0.7MPa industrial steam system.

3. Product Manufacture and Art

3.1 Product Description

3.1.1 Name

Chinese name: 氯化胆碱

English name: Choline Chloride

3.1.2 Molecular formula and molecular weight

Molecular formula: C5H14ClNO, molecular weight: 139.5

3.1.3 Structural formula

3.1.4 Characteristics

3.1.4.1 70%, 75% choline chloride solution is colorless, transparent and sticky with a peculiar odor. It is water-absorbent and it has ammonia odor when absorbing CO₂.

3.1.4.2 50%, 60% choline chloride solid is white or yellow brown (depending on its forms); The dry fluidized choline chloride in form of powder or pellet is water-absorbent with a peculiar odor.

3.2 Process Flow Diagram

Trimethylamine        Hydrochloric acid

\[ \begin{array}{c}
\text{Salifying} \\
\text{Below 45 ℃} \\
\text{Trimethylamine Muriate}
\end{array} \]
3.3 Process Flow Description
3.3.1 Raw material preparation
Water-solution from the storage tank is pumped to the heater, where it will be heated up to 50~80°C, then it will be sent to the High-level tank. After weighing, it will pass through the choline pump for pressurization and atomization. After that, it will be sprayed in the vertical mixer. After platform scale weighing, the corn core carrier is
raised to the mixer by lifting machine. The mixer runs intermittently, completing a mixing curing circulation in approximately 1.5~2 hours. 2 sets of mixers discharge the material alternately to guarantee continuous production of next stage.

3.3.2 Drying

The mixing curing wet material is via the weighing screw and conveying screw sent to the rotary dryer. With the rotation of the dryer, the material is lifted up and down evenly by a special flight so as to carry out heat matter transfer with the hot air uniformly. Along with water evaporation, the dried material will be discharged when its moisture drops to the required value. The dryer runs in counter flow. The hot air from the steam heat exchanger or the hot air kiln will via outlet enter the dryer for heat exchanging with the wet material and carry the moisture in the material with itself. Off-gas will be vented from the inlet of material and enter the wet-method dust collector after dust removing by cyclone. Its emission meets the national standard concerned.

3.3.3 Packing

The dried material is via screw conveyer sent to the return rotary cooler for cooling in indirect way. The cooling water goes through the tube route and the material goes through the shell route for heat exchanging. The cooling water will cool down the material by means of absorbing the heat from the hot material. The material cooled down will be via exit screw sent to the vibrating sieve for separation. The screened material will be discharged manually and the finished product will be via the hopper lifter sent to the temporary storage hopper, packed by automatic packing machine and delivered to the final product silo in the end.

3.4 Production Equipment

3.4.1 Main production equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
<th>Unit</th>
<th>Number</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dryer</td>
<td>set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Rotary cooler</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------------</td>
<td>-----</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Collector</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dust drawing fan</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Feed screw</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Vibration sieve</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Packing machine</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Air heater</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cyclone</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Drawing fan</td>
<td>Set</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Wet type dust collector</td>
<td>set</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

### 3.4.2 Equipment merits

1) Compared to the traditional process, “water-solution process” excels in high efficiency, energy conservation, uniform reaction, good quality, small size, less pollution, continuous operation, easy handleability and wide applications.

2) Homogenization in blending with fine reaction result: The process of water-solution heating and blending enables the material to be completely dissolved in water solution. Corn kernel as the carrier can be mixed with 60% wet choline chloride and the well-chosen vertical blender can make a more homogenized mixture continuously.

3) An effective solution to material adhesion to the cylinder wall: The return-cylinder dryer is of self-cleaning design. When the wet and sticky material being fed into the cylinder of dryer, along with the motion of cylinder, the self-cleaning device, a lifting flight board located in the inner wall of cylinder will pick the material up, lift it up and down and grind it, meanwhile, this self-cleaning device can clean the inner wall surface and the lifting board, effectively preventing the material from adhering to the inner wall. The material, being crushed, has more chance to contact with the hot air for its enlarged contacting surface, and finally, through heat and mass transfer it can be dehydrated to achieve the required hydrous rate and will be discharged from the cylinder. The fine particles being carried by hot air will be collected by dust-collector; while the cleaned off-gas is to be released.
to air. The final product is good-quality, spotless in fine powder form. This set of equipment can produce choline chloride continuously and it’s ideal for production of choline chloride, suitable to different carriers as well as other non-plant additives of choline chloride as the carrier.

4) Environment friendliness: The dehydrated off-gas will be treated by the cyclone for removing dust and then be blown into the dust collector to further remove the dust in “wet-method” and the clean off-gas is released to air.

5) Hot air kiln and the heating source of steam can be alternately selected according to the need of user.

6) A continuous and automatic production can be realized by this set of equipment with convenience and smoothness in operation. Parameters for the measuring screw, dryer, and cooler can be adjustable, making the flexible operation possible. Even if the feeding water is fluctuant in amount, the whole system can still run in a steady and smooth manner.

7) The whole set of equipment is of type under atmosphere pressure, easy and reliable to handle with low rate of malfunction.

3.4.3 Production zone arrangement

The production zone arrangement shall conform to the requirements for process, construction, hygiene, fire protection, personal protection, transportation and land saving, making full use of the geographic advantage and dividing distinctly based on functions. The various piping should be neatly-arranged, accessible to production in nice style. Short-term construction should be combined with the long-term development. The greening design should be taken into account.

According to the whole process flow, the production zone is divided into section of power, section of the raw material, section of operation and section of office administration.

The supply for power and steam should be accessible to the main workshops as close as possible. The production zone should have the circular fire passages and water supply-drainage lines.
3.5 Environmental Protection and Safety Production

3.5.1 Disposal of the three wastes and preventive measures

1) There is no residue generated from the production of choline chloride;
2) During the process of production, small trace of trimethylamine gas, ethylene oxide gas can be adsorbed by diluted hydrochloric acid or the trimethylamine muriate.
3) Besides, the waste water harmless to environment can be discharged directly.

3.5.2 Occupational protection and safety protection

The raw materials used in this workshop like trimethylamine and ethylene oxide are toxic, flammable and explosive, which demands that the workshop shall be preventive of fire and explosion. The specific regulations are as follows:

(1) The raw material in workshop should be looked after by someone and stored in dry, cool and well-ventilated shade area.
(2) The handing and receiving of the raw material should need the signature from the two person involved.
(3) When the operators and other personnel enter the workshop, they are not allowed to carry the matches, the cigarette lighter and other flammable objects.
(4) The personnel entering the workshop are not allowed to wear shoes with nails;
(5) When knocking or striking with tools, we should prevent from the spark arising and it is suggested that we should use the wooden hammer or the rubber hammer.
(6) Prior to the overhaul or cold repair, some precautionary measures should be adhered to in the workshop.
(7) The copper wrench should be used for handling ethylene oxide;
(8) Handle the iron barrels or other objects with cautiousness so as not to generate sparks;
(9) Prior to any repair or open fire operation like the welding work, the place shall be cleared. After that, it should be approved by the relevant authorities. Besides, the fire protection facilities and apparatus should be prepared at hand.
(10) Fire fighting apparatus should be stored at a fixed place, accessible to handle
with. It should be checked every week and replaced with the new one if necessary
(11) The electrical appliance should be explosion-proof and checked regularly. Its
status must be clarified during proceeding of shift handing-over. The workshop leader
should be reported immediately when something wrong happens.
(12) No smoking or opening fire work is allowed between the space of 30m around
workshop.
(13) The operators must wear the protective clothing according to the regulations
(protective work uniforms, gloves, safety glasses and so on)
(14) The workshop must keep clean and neat and the flow of personnel and material
should be orderly without mess.
(15) If anything wrong happens to the equipment or parts within the workshop is
noticed, it should be reported promptly to relevant personnel. Actions should be taken
carefully.

5. Business Scope and Technical Support

With fully-equipped pilot base and hundreds of experienced engineers, Tianli R&D
Institute can provide technical support and services involving design, manufacture,
process optimization, upgrade and innovation. Besides, we furnish one-station service
as the EPC contractor, responsible for on-site installation, commissioning, training to
site operators from the customer and start-up. Our business scope covers the
following:
(1) The Rotary Cylinder Dryer Series for 5000-1000ton/year Choline Chloride
Production
(2) The Fluidized-bed Dryer Series for 5000ton/year Choline Chloride Production

6. Economic Benefit Analysis

The new generation of drying system for choline chloride production developed by us
is of low energy consumption, high thermal effect, less operating and maintenance
charges. This drilling mud treatment system economically and environmentally excels
the other one in the same field with high financial profit and short period of
investment return.