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Resource Promotion of Ammonification Straw

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Abstract: China's crop straw resources are large and widely distributed. However, these phenomena are limited to mountainous areas, hills, economically developed metropolis and suburbs of medium cities; moreover, straw is not the main source of crop straw. This wastes resources, not only waste, but also pollute the environment. With the rapid development of animal husbandry and industry, straw resources are paid more and more attention, but the rate of straw resources in Japan is still at a low level compared with developed countries, and there is still a big gap compared with developed countries.

1. Distribution and utilization status of straw resources

At present, the utilization of straw resources in China can be mainly divided into three aspects: (1) Straw can be used as an industrial raw material, mainly used as raw material for paper industry and handicraft industry.(2) Straw can also be used as roughage for herbivorous livestock. Gao Xiangzhao (2002) according to the national agricultural technology popularization service center in 2020, the utilization of straw resources analysis, found that fertilizer (including direct returned) straw use in China, accounting for 36.6% of straw resources, followed by fuel and feed, utilization of 33.7% and 12.26% respectively, other raw materials, burning, illegal dumping, etc. In 2020, the utilization of straw is also analyzed by crop straw, wheat, rice and other straw account for more than 45%, the proportion of grain and peanut straw used as feed is more than 45%, while cotton and bean straw are mainly used as fuel. The most common types of straw include rapeseed, wheat, corn and rice, accounting for more than 5%. According to statistics in 2020,20.29% was used as raw materials for papermaking, 30.9% was used as livestock feed (14.8% processed feed, 16.1% unprocessed feed), 45% rural living energy, 45% animal feed, and 20% feed.21.2% is the straw returning to the field loss. For the experts, the results of these statistics are different. From the perspective of straw utilization in each region, in Gansu, Ningxia, Anhui, Fujian, Heilongjiang, Shandong, Zhejiang and other provinces, the proportion of straw as feed is relatively high, reaching more than 30%, while the proportion of Shanghai and Hunan provinces is relatively low, less than 10%; it has ended. In Hunan, Jiangxi and Shanxi provinces, the proportion of straw as fertilizer is high, reaching more than 60%, but the proportion of Ningxia, Sichuan and Guizhou is low, less than 20%, and the proportion of straw returning to the field is low.The utilization rate of straw is relatively high. Due to the less raw materials, only Fujian and Ningxia provinces have more than 10%, while Hebei, Shandong, Guizhou, Shaanxi provinces have the highest straw waste and stacking amount, more than 10%. Straw directly returning to the field or retting system, the recovery rate of nitrogen, phosphorus and potassium is high (100%) (Gao Xiangzhao et al., 2002).

Agricultural production: ① bacteria and eggs attached in straw soil. Straw transplanting into the soil, breeding and spread, diseases and insect pests spread. The straw should not rot, so that the seed is in full contact with the soil, affecting the germination rate and hindering its growth. It requires a lot of manpower and capital investment. By returning straw to the field, part of the nutrients contained in straw can be transformed into livestock products, saving food, making up for the shortage of forage and reducing pollution, so as to achieve emission reduction. The decomposition speed of livestock manure is faster than straw, which is conducive to land preparation and moisturizing. In addition, straw burning seriously pollutes the environment, increasing the concentration of sulfur dioxide in the atmosphere several times, but in addition, livestock and poultry manure increases the soil fertility, improves the physical and chemical properties of the soil, can improve the soil, and avoid soil deterioration.

2. Principle of straw ammonification

The reason why ammonia treatment can improve the nutritional value of inferior forage grass is due to the triple effect of ammonia on straw alkalization, ammonification and neutralization.

In the process of ammonification, when the NH3 generated by the decomposition of the free ammonia source meets the straw, the following ammonia decomposition reaction will occur with the organic matter in it."

Ammoniation

R-COO-R'+NH3—R-CO-NH2+HO-R'

R: polysaccharide chain

R ′: the hydrogen atom of the polysaccharide chain or hydroxybenzene or the phenylpropane unit of the lignin

The aminidysis reaction breaks the ester bond between lignin and the polysaccharide to forming the ammonium salt. Nitrogen compounds, digested and absorbed in the lower gastrointestinal tract together with feed proteins, meanwhile, rumen microorganisms obtained the nitrogen compounds. Sources required for growth, and thus their activity was significantly increased and digestion of the feed increased[1].

2.1 Alkalalization

Straw is rich in carbohydrates, most of which are components of cellulose, hemicellulose, lignin, cutin and other cell walls. Lignin and cutin themselves are not only difficult to digest, but also closely embedded in cellulose. The ammonia (NH3) ammonia source contacts with the water in the straw to form NH4OH. The hydroxyl radical of NH4OH weakens the hydrogen bond in the feed fiber, swelling the fiber molecules, and can dissolve hemicellulose and saponified sugar. Aldehydes and acetate neutralized the bond between cellulose and lignin, making it more easily utilized by ruminant microorganisms.[2] Therefore, the alkalization part degrades cellulose, hemicellulose and lignin, blocking the tight relationship between cells, thus increasing the permeability, enabling the cow and sheep digestive fluid and bacterial enzymes to directly contact with cellulose and hemicellulose, and a small amount of lignin is dissolved to form hydroxylignin, which improves the digestibility of straw.[3]

2.2 Neutralization role

Ammonia-treated straw is an alkaline diet, which can provide some degree of relief if the rumen pH is decreased by feeding abundant concentrate or silage.[4]

On the other hand, ammonia is alkaline. When straw is used to process inferior feed, it can

neutralize organic acids, remove acid roots, reduce feed acidity, inhibit the activity of rumen microorganisms, and create good environmental conditions.

2.3 Effect of ammonification on straw

2.3.1 Effect of ammonification on the chemical characteristics of straw

Crop straw is composed of plant cell walls and cell contents, which generally account for more than 80% (Van Soest, 1994), and its basic components are cellulose, hemicellulose and lignin (Hartley, 1981). Lignin is one of the main factors hindering the microbial digestion of ruminants, ammonia straw only ferlic acid significantly reduced, the three phenols in digested core lignin significantly reduced, indicating that ammonia treatment can improve the digestion characteristics of core lignin GLC analysis showed that ammonia treatment on the structure of straw cell wall polysaccharide. The effect of ammonia treatment with urea, ammonium bicarbonate and ammonium bicarbonate was not as obvious as that of ammonia. Zhang Fulin (1995) found that HPLC analysis showed that coumaric acid and ferulic acid were significantly reduced after treatment with ammonia at normal temperature ($P < 0.05$), and the reduction rate was 61.5% and 65.8% respectively compared with untreated corn. [5]They significantly decreased the core lignin. Guo Peiyu (1995) found by HPLC analysis that the phenolic compounds in straw were significantly reduced after urea treatment, indicating that the urea treatment could partially dissolve lignin. After treatment of coumaric acid and ferulic acid significantly reduced, indicating that the bond between lignin and structural carbohydrates, hemicellulose partially dissolved, GLC analysis shows that urea treatment, found the degradation of structural polysaccharide in straw significantly reduced, that urea can partially dissolve structural polysaccharide, the main component of hemicellulose xylose and arabinose also significantly reduced, that urea can partially dissolve hemicellulose (liu Dan, etc., 2004).

2.3.2 Effect of ammonification on the physical characteristics of straw

The increase in water holding and swelling abilities soften plant tissues and increase the utilization of microbial digestive enzymes, thus improving the degradation of plant polysaccharides. Specific porosity and bulk density reflect the changes in the macrostructure of straw plant tissues. The effects of ammonia treatment on the physical properties of straw mainly include bulk density, specific porosity, expansion capacity, water holding capacity, etc. Zhang Fulin showed that the bulk density of corn straw and rice straw decreased slightly, but the difference was not significant. The swelling force increased by 6.5% and 25.6%, respectively, indicating significant swelling of plant tissue after soaking. Reported that the specific porosity and hydraulic force both increased slightly, but the difference is not significant.

2.3.3 Effect of ammonification on straw tissue structure and cell wall structure

Crop straw contains four tissue types: epidermal tissue, vascular tissue (phloem and xylem), and basal tissue (including sclera and parenchyma). Thin-walled tissue is prone to digestion by rumen microorganisms, and the epidermis (with keratin wax silicon layer) Shen et al. found that thick-walled tissue and chemically chemical vascular tissue in wood are difficult to be decomposed and digested. The dissolution of a small amount of cuticular wax silicon layer can destroy the vascular bundle wall and expand the parenchymal tissue. It was observed that both treatments caused distortion of the parenchymal tissue, causing cracking of the epidermis and internal cuticle, resulting causing rupture of the epidermis and internal cuticle. Helps to the complete formation of parenchymal tissue and phloem, treated with ammonium carbonate, stem soft, wrinkled, pulp cavity

deformation, beads, nipple, bristles, hair and other siliceous tumor-like structure collapse and shedding, leaving traces, vascular bundle deformation, ammonification straw fiber tissue clear, mechanical fracture, lead to tissue contraction, cell wall contraction, cell cavity contraction. The fibers at the edges were heterogeneous, and numerous fragments were observed. "The cell wall thickness was significantly increased after ammonia treatment, ranging from 17.5% to 139.8% depending on the position. The average increase was reported by 68.5%, indicating a loose cell wall, generating interspace, and cell wall expansion, creating space for gastric fluid entry, facilitating the growth of rumen microorganisms, and creating conditions for improving the digestibility of straw. After pickling, it was found that the transparency of the straw treated with ammonia was better than before washing, the cell structure was roughly visible, the epidermis was damaged, and the tissue cells fell off. It was found that the fiber was basically unchanged, and there was a certain degree of change. Central fibers are present, the tissue layer is transparent, internal parenchyma cells are shed, and pores are clear. The ammonia straw, after alkaline pickling, showed good transparency, further broken tissue and obvious pores. There are some cracks, many parenchyma cells fall off, and the fibrous structure is damaged to some extent, and the cell wall is observed. It destroys some fibrous tissue separation and loosens the structure.

2.3.4 Effect of ammonification on the nutritional value of straw

Straw ammonia treatment increased the straw crude protein (CP) content, significantly reduced the acid washing fiber (ADF) and neutral washing fiber (NDF) content, significantly increased the cellulose content "Mao Huaming (1991) reported that wheat straw after urea treatment CP content doubled, corn straw after liquid ammonia and urea treatment CP content doubled. "Wheat straw and corn straw after ammonia treatment, neutral washing fiber down 7-8% corn straw after ammonia treatment, lignin content has a downward trend chun-long liu (2002) study found that after urea treatment, straw CP content increased by 10.3% Xue Zhimin (1997) reported ordinary straw protein content is 4.41%, after ammonia treatment can reach 9.55%.%, Up by 5 percentage points."" Ammonia treatment also significantly improved the digestibility of straw, reaching the level of medium hay. By Zhou Yajuan et al., the degradation rate increased by 11.48, 8.03 and 7.52 percentage points, respectively.

2.4 Aminination mode

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2.4.1 Stacking method

First of all, we can lay a layer of polyethylene plastic film on the ground according to the size of the pile, and then stack the straw ammonia treatment method similar to liquid ammonia on the ethylene film (same as the basement (pool) method), in the process of pumping ammonia stacking,

or in the upper ammonia tank, open the lid, ammonia directly into the ammonia inlet, and seal the chimney.

The production cycle of the stacking process is temperature sensitive because the reaction rate between ammonia and organic matter varies with the ambient temperature. In general, if the daytime temperature is above 30℃, the ammonia treatment takes 5-7 days, if the daytime temperature is 2-30℃, and if the daytime temperature is 10-20℃, the ammonia treatment takes 10 to 14 days.14 to 20 days if it is 0 to 10 °C and 28 to 56 days if the daytime temperature is 0 to 10 °C. After the ammonia treatment is completed, the straw pile is opened, but the straw pile usually needs to be exposed to the air for several days to release the excess ammonia and then sent to the shed (Xue Yajie, 1994).

Stacking method is the most widely used method in Japan, and it has the advantages of simplicity and low cost. However, the stacking method takes a long time and covers a large area, which limits its application in large and medium-sized breeding farms.

2.4.2 Small-scale vessel method

Before ammonia treatment, the straw can be chopped into a hay machine, or the whole plant or the whole bundle can be ammonia treatment. If liquid ammonia is used, add water to the straw, so that its water content reaches about 30% usually (water content) the content of dry straw is about 9%), and then put it into the container to seal, with ammonia inlet. Liquid ammonia equivalent to 3% of the straw was injected into the straw.We dissolve 5-6% urea in water and mix it evenly. It is evenly poured into the straw, so that the water content of the straw reaches 40% and then put into a closed container. The total amount is constant, the safety of the pit is poor, and the mold is easy to breed in the heavy rain season (Xue Yajie, 1994).

2.4.3 Aminidization furnace method

Heat the straws in sealed containers to 70 to 90 degrees Celsius for 10 to 15 hours, then stop heating and leave them in the sealed state for 7 to 12 hours. When the stove is turned on, the remaining ammonia is suspended in almost one furnace a day.

Ammonia furnace has civil ammonia furnace of brick cement structure and ammonia furnace of steel structure. Civil engineering ammonia furnace is brick wall (internal specification: 3.0×2.3×2.3m), cement plastering coating, single side and double door. Door frame and door edge use of 55 corner iron, lined with asbestos or other insulating materials.speaking. In order to prevent fire, heating pipes are installed at the bottom of the left and right side walls, and the distance between the heating pipes and the material carrier is at least 30 cm. There are exhaust ports at the top and bottom of the center of the rear wall, which is connected to the fan and pipe outside the wall. The number of heating pipes is calculated at 500 watts per cubic meter. Turn on the fan during heating to balance the ammonia concentration and temperature in the room. Ammonia sources can be liquid ammonia or carbon ammonia, but urea is usually not used.600 kg of straw.

Steel frame ammonia furnaces can reuse aging fermenters, iron tanks and containers."During the renovation, the interior walls will be coated with corrosion-resistant paint, and the exterior walls will be wrapped in asbestos and fiberglass for insulation. When using old containers, 81.6 kW heating tubes are installed on the back of one wall, totaling 13 kW. Open two upper and lower vents on the back wall facing the heating pipe, and connect with the fan and pipe outside the wall. Turn the fan when heating to make the ammonia concentration and temperature uniform. The internal size of the container is 6.0×2.3×2.3m, and the amount of primary ammonia treatment straw is 1300kg.

Although the one-time investment of ammonia furnace is more expensive, it has high durability,

high production efficiency, comprehensive analysis, and high cost performance (the plastic film used in the lamination method is only used twice). In particular, the addition of ammonia recovery device can reduce the amount of liquid nitrogen by 3% 1.5% 2%, and further improve the economic benefits. Norway, Australia and other countries using vacuum ammonia treatment of straw treatment has achieved good results.

3. Conclusion

The main raw materials of amination include grass and grass straw. The amount of water added with straw affects the ammonification effect of straw. If there is too little water in the straw, water will occur. As the "carrier" of ammonia, if the water content of straw is too high, the ammonification effect will be reduced. Just need to extend the drying time after opening, but at the same time the straw is more likely to mold and deterioration. Water content is generally between 30%~40%. The distribution of water in the straw will also change. In order to affect the ammonification effect, attention should be paid to keep the water distribution of the upper and lower layers uniform.

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