Understand The organic fertilizer technology

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The oversea business manager
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Section 1 China organic fertilizer development status and industry standards

Section 2 The organic fertilizer production technology

Section 3 Organic fertilizer testing technology and its calculation method

Section 4 The commen organic fertilizer quality judgment

1 One

A. China organic fertilizer developing status

B. Industry standards

The market status and industry analysis

In China, the continuous application of chemical fertilizer, caused great problem, like the soil fertility loss , and unbalanced nutrition of the field, brought impacts to the ecological environment, the soil physical condition, and the microbial colony , all the damage can be in different level, which lead to the the agriculture product safety.And over application of chemical fertilizer, also has the flaw of low inefficiency, and low utilization, and soil cake.In western countries, bio organic fertilizer already be com men applied around 50% .

According to the statistic , the ratio of organic fertilizer in total application , in 1949, is 99.9% to 37.4 % in 1990, till 2000, dropped to 30.6%, in 2005, dropped to 25%, the collaboration of organic and non organic fertilizer has been the principal and trend.

China has great rich natural resource of biomass suits for fertilizer, not only animal manure, corps straw, sea weed, the total green fertilizer can be more than 100 million ton per year, which contains great amount of nutrition, around 70 million ton, accounts for the total applied chemical fertilizer 1.46 times.

To industrialize the organic fertilizer production,and harmless treatment, the conception is to collect, ferment, and dehydrate , deodorant locally, and granulate to industrial manufacture it as commercial fertilizer ,adopt the method of “pre treatment, then use it , and benefit” modern organic fertilizer new route, can greatly improve the utilization of the animal dung from husbandry , and the civilian rubbish.

With development of living standards, and the Eco friendly agriculture, the non contamination “green food” has been in demand from consumers, to reasonable apply the chemical fertilizer with organic fertilizer is a must trend for modern agriculture.

B the characteristic of the organic fertilizer industry

Key point 1: Green and environment friendly

Key point 2: Techno logic of the products, not only adopt high Bio tech, also improve the agriculture workers life and working condition, also became another economical profit point for animal cultivation

Key point 3:Industrialize the organic fertilizer as industry. From farm house level to up scale production, China organic fertilizer has stepped in a new stage.

C The market potential of organic fertilizer

With people living standard developing, the demand of “Green food ” keeps increasing, and organic fertilizer is the basis for “Green food”, so special formulation of “living bacteria fertilizer”, “active organic fertilizer” “Bio chemical compound fertilizer” is the leading products in this area, which has the nature of non pollution, and Eco friendly.

According to FAO annual report(World grain & agriculture organization), the world fertilizer developing trend is : diversified, multi function, high efficient, and high concentration.

The non pollution trend”: combination of organic , biological, and chemical components, in developed country, 70-80% is compound fertilizer with chemical and biological fertilizer, and functional fertilizer in application, while also apply the biological fertilizer and new type of fertilizer, in China mainland, the new type compound fertilizer , plus bio fertilizer accounts less of 10% of total fertilizer, which predicted the the great potential in future.

The organic fertilizer quality control parameter

Item	Data
有机质的质量分数The organic quantity data（以烘干基计measure as dry matter）/（%）	≥45
总养分Total nutriment（N+P2O5+K2O）quantity的质量分数（以烘干基计measure as dry matter）/（%）	≥5.0
水分（鲜样）的质量分数Moisture quantity(fresh) quantity/（%）	≤30
酸碱度（pH）	5.5-8.5
总砷（As）（measure as dry matter以烘干基计）/（mg/kg）	≤15
总汞（Hg）（measure as dry matter以烘干基计）/（mg/kg）	≤2
总铅（Pb）（measure as dry matter以烘干基计）/（mg/kg）	≤50
总镉（Cd）（measure as dry matter以烘干基计）/（mg/kg）	≤3
总铬（Cr）（measure as dry matter以烘干基计）/（mg/kg）	≤150
类大肠杆菌群数/（个/g）E.Coli count (/g)	≤100
蛔虫卵死亡率/Ascaris eggs mortality（%）	≥95

Microorganism organic fertilizer

Specified the certain functional microorganism to work on the animal or plant dead scrape (like animal dung, agriculture straw etc), after non harmful treatment, and composting the organic materials, blend into fertilizer both has the effect of microorganism fertilizer and organic fertilizer.

Microorganism organic fertilizer

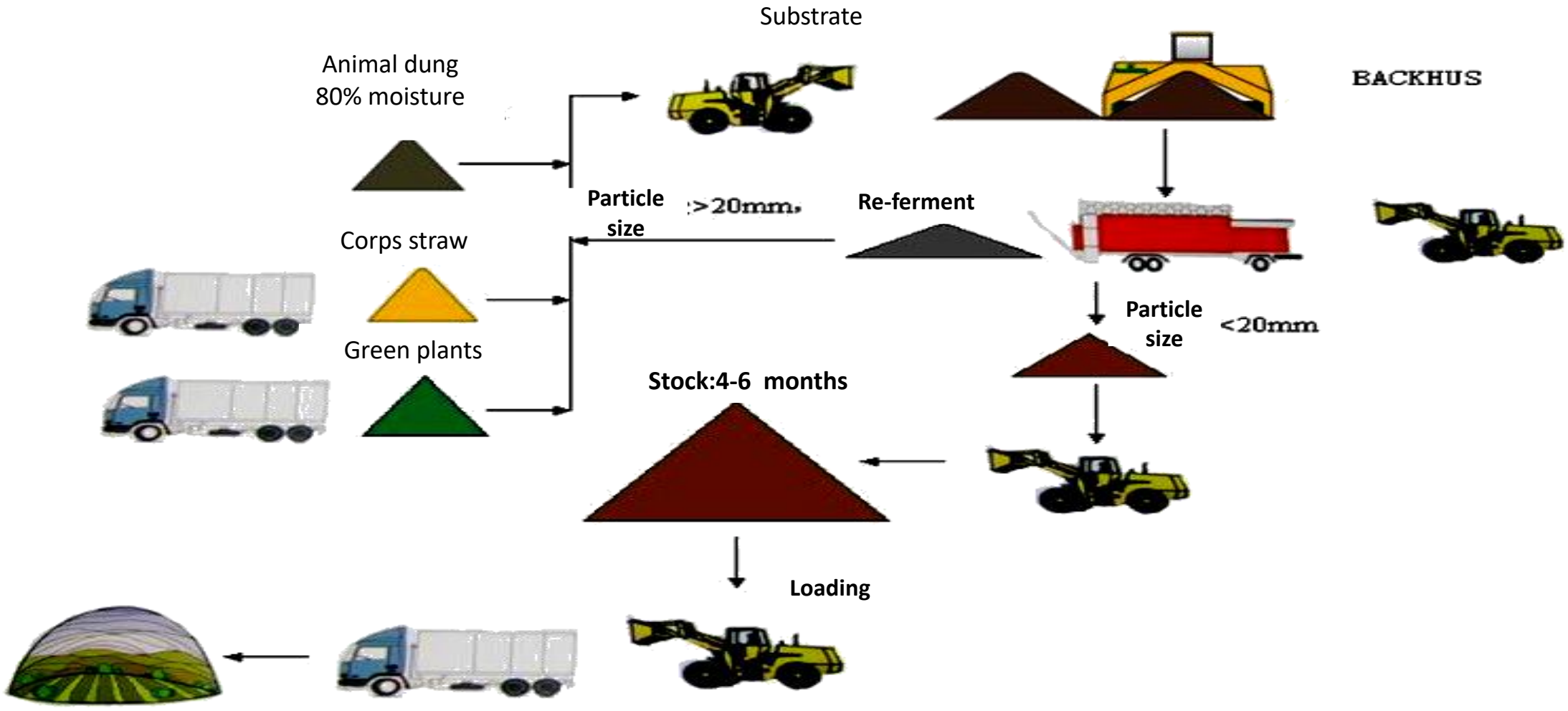
Item	Data
有效活菌数 The living bacteria account（cfu），亿100,000,000/g	≥0.20
有机质（以干基计）Organic material (measure as dry matter)，%	≥40.0
水分（鲜样）的质量分数Moisture quantity(fresh) quantity/（%）	≤30.0
pH	5.5-8.5
总砷（As）（以烘干基计）(measure as dry matter)mg/kg	≤15
总汞（Hg）（以烘干基计）(measure as dry matter)mg/kg	≤2
总铅（Pb）（以烘干基计）(measure as dry matter)mg/kg	≤50
总镉（Cd）（以烘干基计）(measure as dry matter)mg/kg	≤3
总铬（Cr）（以烘干基计）(measure as dry matter)mg/kg	≤150
粪大肠菌群数，Fecal coliform member个/g	≤100
蛔虫卵死亡率，Ascaris eggs mortality %	≥95
保质期，月Shelf life ，Month	≥6

2 Two

A The theory of utilize the animal dung to manufacture produce organic fertilizer

B Organic fertilizer Aerobic composting technology

C. Organic fertilizer production line

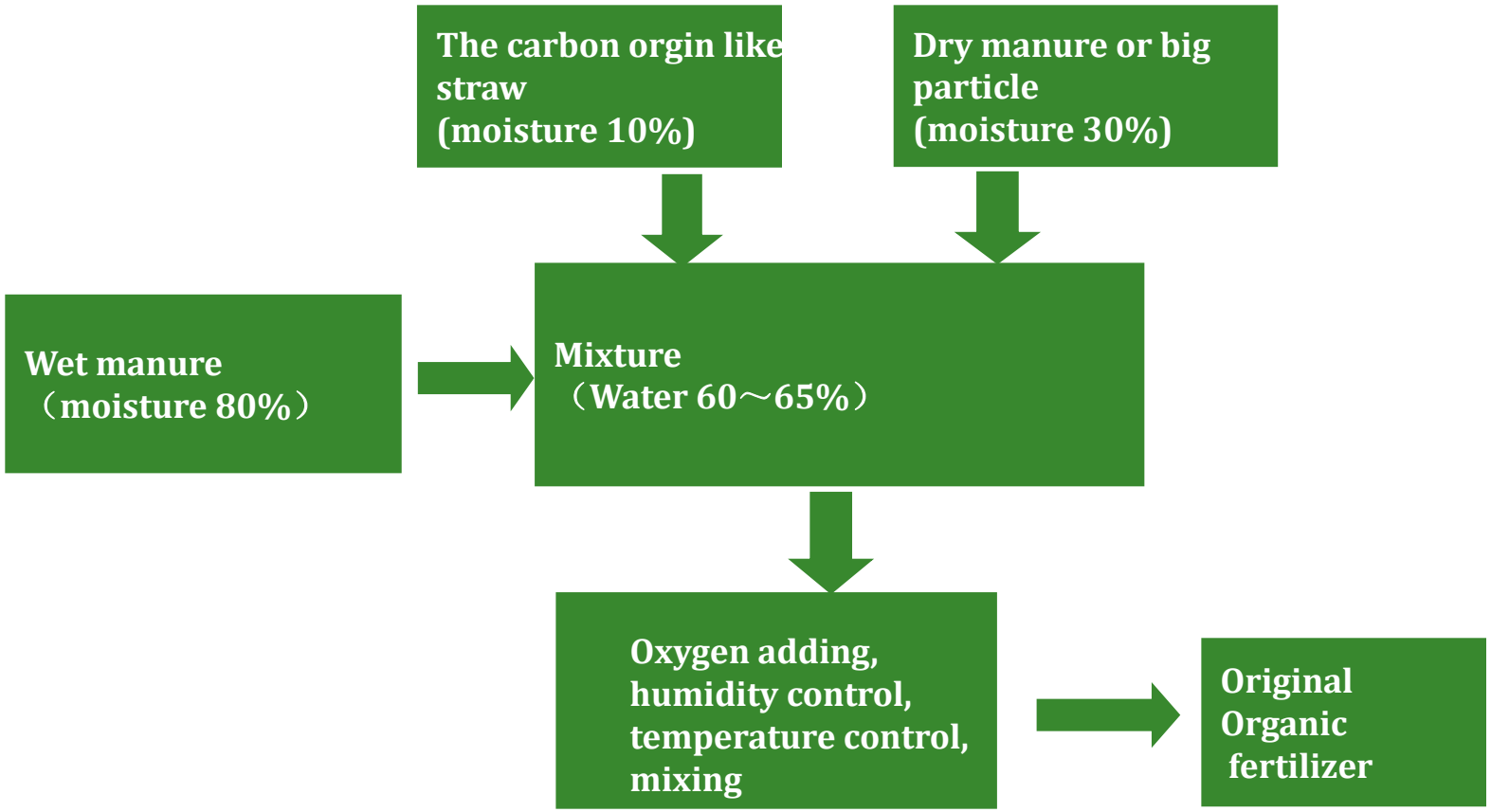

Substrate
Animal dung
80% moisture
BACKHUS
Particle
size
>20mm,
Re-ferment
Corps straw
Green plants
Particle
size
<20mm
Stock:4-6 months
Loading

1. There are multi bacteria in the compound culture,in the 4 stages of fertilizer composting, each take its responsibility, fully release the fertibility and preserve its strength.

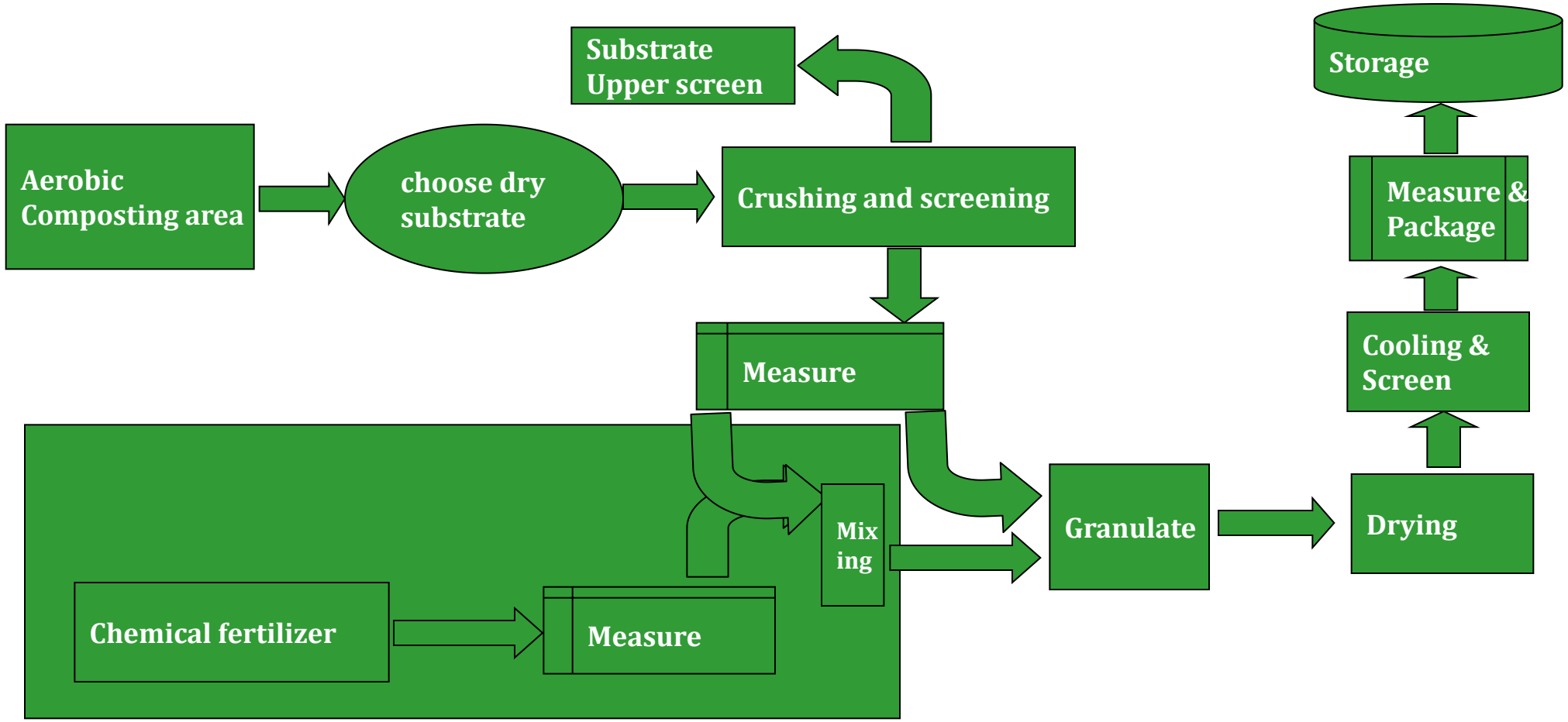
2. After the bacteria culture high temperature treatment, effectively kill the Pathogens, eggs, weed seeds;

3.The secondary metabolites from the multi bacteria compound,has the function of disease resistance, pest proof, and growth promoting.

4. Short fermentation time, only need 10- 15 days can complete.



Note: All the data is approximate, in the process of composting need adding oxygen, humidity control, temperature control, and mixing thoroughly, to un harmful composting the substrate.


Aerobic Composting area
choose dry substrate
Substrate Upper screen
Crushing and screening
Measure
Chemical fertilizer
Measure
Mix ing
Granulate
Drying
Cooling & Screen
Measure & Package
Storage

The conception of Aerobic composting

The Aerobic composting is under the condition of oxygen involved, the aerobic bacteria treat the substrate with absorbency, oxidization, and degrading. the microorganism works with itself life activity, to absorb the organics , oxidant it into simple organics, while release the energy that can support the growth of the microorganism, and other parts synthesis of new cytoplasm, enable the microorganism keep reproduction, to produce more biological matters.

Under human control, with certain moisture, C/N ratio and good ventilation condition,after microbiological fermentation, to convert the waste organics to fertilizer, the process is called organic fertilizer aerobic composting

15-45°

Degrade the easy degradable organics (saccharides, starch, protein, etc.)

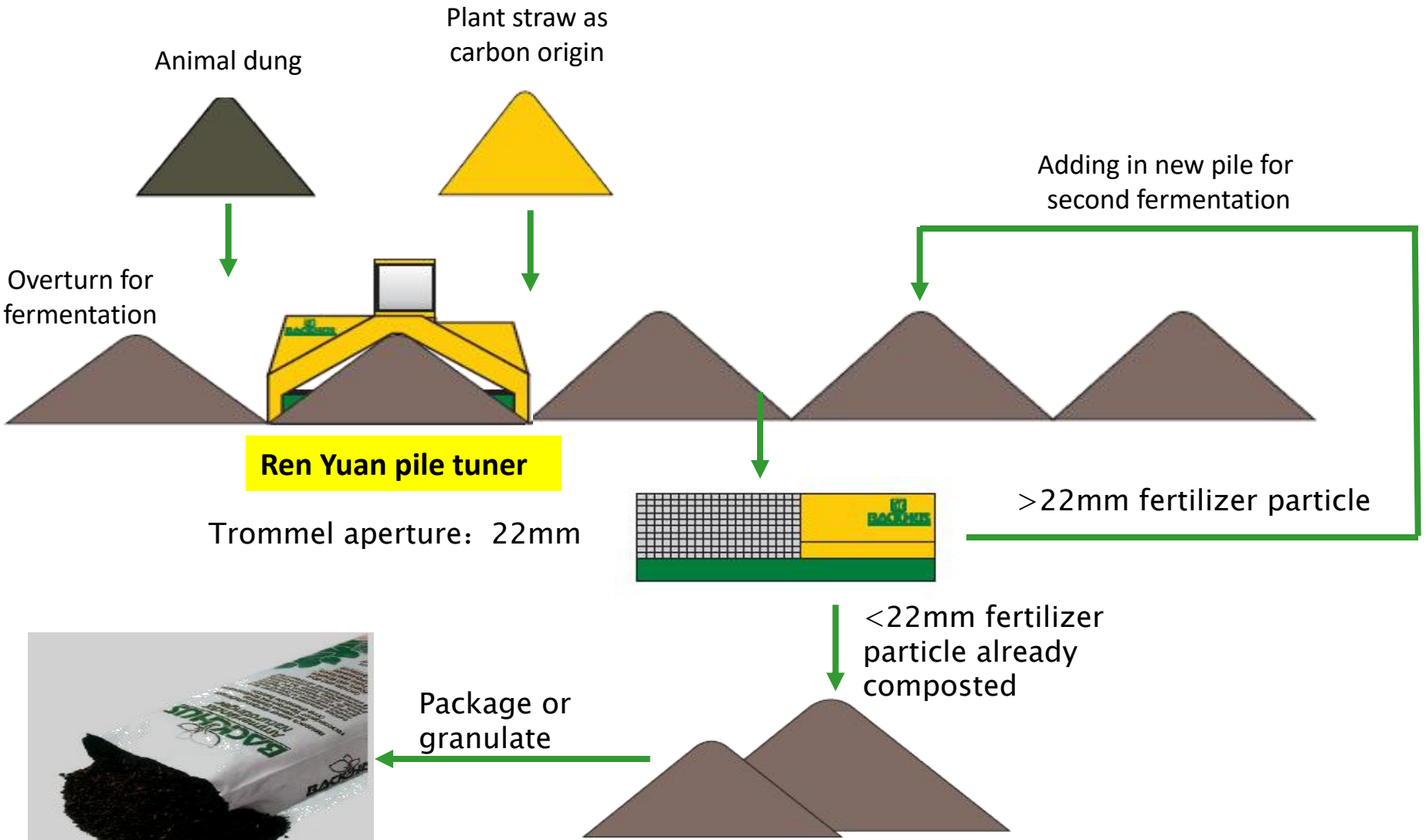
45-70°

Under 60-70°， great amount of thermophilic bacteria cell dead or dormancy, repeated several times, to achieve un harmful disposal.

40°

Mesophilic microorganisms became advantageous breed,enable to degrade the hard organics, coming into composting stage.

Compress the fertilizer pile, the organics substrate stay in Anaerobic conditions, preventing mineralization happens.


Animal dung
Plant straw as carbon origin
Overturn for fermentation
Adding in new pile for second fermentation
Ren Yuan pile tuner
Trommel aperture：22mm
>22mm fertilizer particle
<22mm fertilizer particle already composted
Package or granulate

（1）The particle size: this project relating animal manure and the straw particle should be smaller than 10 mm.

（2）The water content: the moisture content is the priority of considered parameter, if all the mixing substrate moisture already 65%, that no need to re adjustment.

（3）C/N：C/Nis the raw substrate main adjustment parameter need to considered, C/N ratio should be the range of 25-35：1

The main Material: Means the main material in the fertilizer composting, normally accounts for 30-80%, consist of one or several substrate,like animal dung, plant corps, civilian sludge, or sugar can Cane filter mud.

Corps stalk

Animal dung

Supporting material： Means the supporting material to adjust the moisture, C/N, pH and the penetrating supporting material,normally consist of one or few other substrates, like corps stalk, rice husk, wheat barn, feed cake, straw carbon, mushroom culture cake,Lime, rock phosphate and super phosphate

Carbon origin

The high organic carbon contents material like: agriculture straw, stalk, rice husk, wheat barn, grass carbon, mushroom culture cake

Nitrogen origin

Means the material C/N ratio under 30 , normally is considered as the main material in fertilizer composting, like animal dung, civilian sludge, and sugar cane filtration mud.

Conditioner

The substrate to adjust the pH and C/P ratio,normally is lime, gypsum and acid, etc.,

Moisture Adjustment

Temperature control

Oxygen Adding

Mixing uniformity

（1）Temperature control：When the inner temperature of the heap raised to 60-65℃, and sustain for 2- 3 days, to eliminate the stink and kill the fly eggs and maggot as standards；

（2）Heap turnover control：when the temperature is standard, and the heap temperature was over 65℃ , after 24hrs , then turnover, the turnover times is verified with the different seasons.

（3）The flavor standard：In the stage of composting, after 48 hrs, the temperature has not reached 55℃,and still stinks,need to consider if the moisture contents is correct for aerobic fermentation, if the supply of oxygen is enough.

Main material
Supporting materials

Tunnel tuner (Continuous)

Automatic supply silo

Sliding filter

Crusher

Granulator

Dryer

Cooling agent

Selecting separator

Automatic package machine

The production system line of 10000-50000 ton/ yr granula

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Function: the material piling,Shovel, loading, transport and unloading

Noted : Recommended brand Reliable

XCMG 徐工机械

LiuGong 柳工

Ren yuan Biological full hydraulic intelligent turner, economical cost, applying German technology and processing capability (high humidity of materials is also applicable), plus crawler track cleaning, CVT and other advantages, leading in China made brand, suitable for up scale production.

Function: Temperature control, oxygen filling, moisture removing, mixing evenly

Tunnel turners is a type of turner, another name is called rail turner. Ren Ruan `s technological innovation-automatic control system reverse overturn, enable it compatible with solar fermentation, fermentation tunnel, Transitional machine, which can support multi tunnels, can be discharged continuously or batch discharge.

The reason for choose: portable, convenient for operation, high efficiency, flexibility in production, easy to maintain, suitable for each particle and middle hardness block substrate.

Function: crushing the substrate, serve for the granulation.

The technology features: pipe in steam, ammonia gas inside the machine, also can add in Phosphoric acid or ammonia solution, ammonium phosphate slurry, slurry TSP, all the chemical reaction , and heating supply ,mixing ,granulating process happened inside the machine, also can supplement little quantity of water which evaporated in granulation process,when the solid fertilizer particle for granulation, need the drum rotary motion, to produce material spray on the particle surface, coating each layer, to granule finally.

The granule dryer choose need to decide by the substrate moisture, productivity, granular penetration physical features, also need to consider of the energy consumption, price .The ones of high efficiency, and energy saving should be the priority to consider.

3 Three

A. The com men used Organic fertilizer analysis equipment

B. The organic fertilizer analysis theory and calculation

method

Weight tool

Sample heating

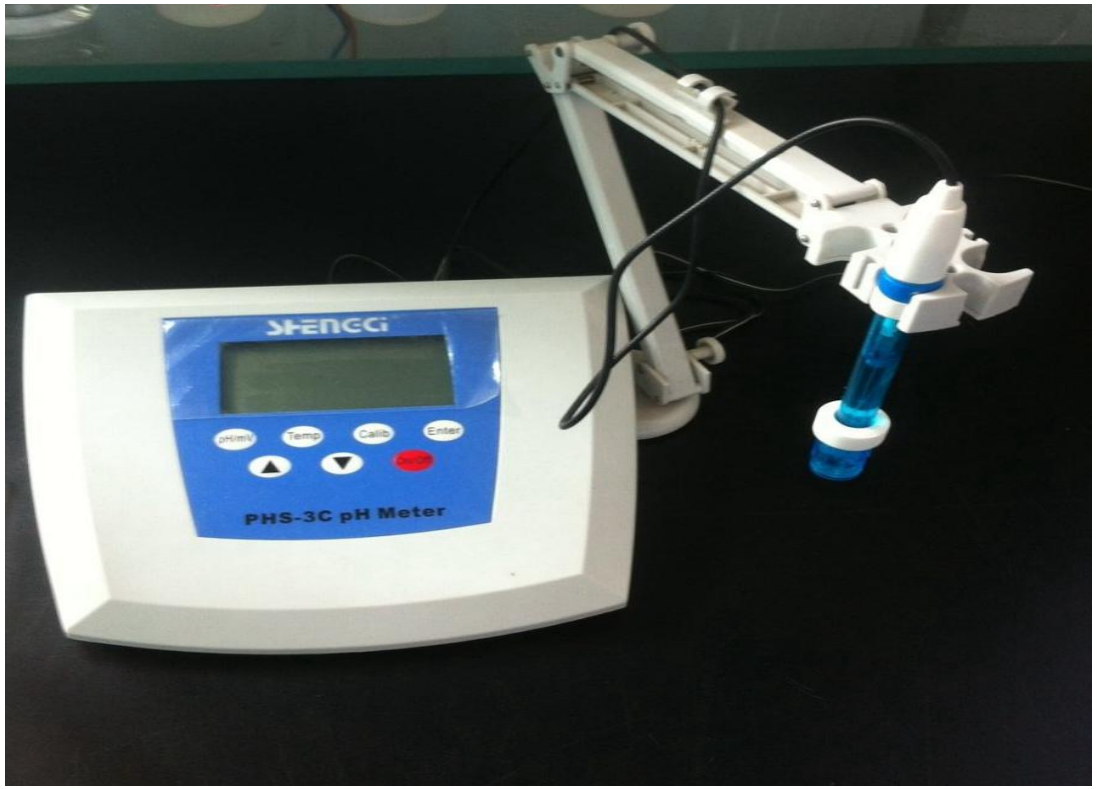
digestion furnace

Fume Hood: Pumping exhaust canceled when cooked material

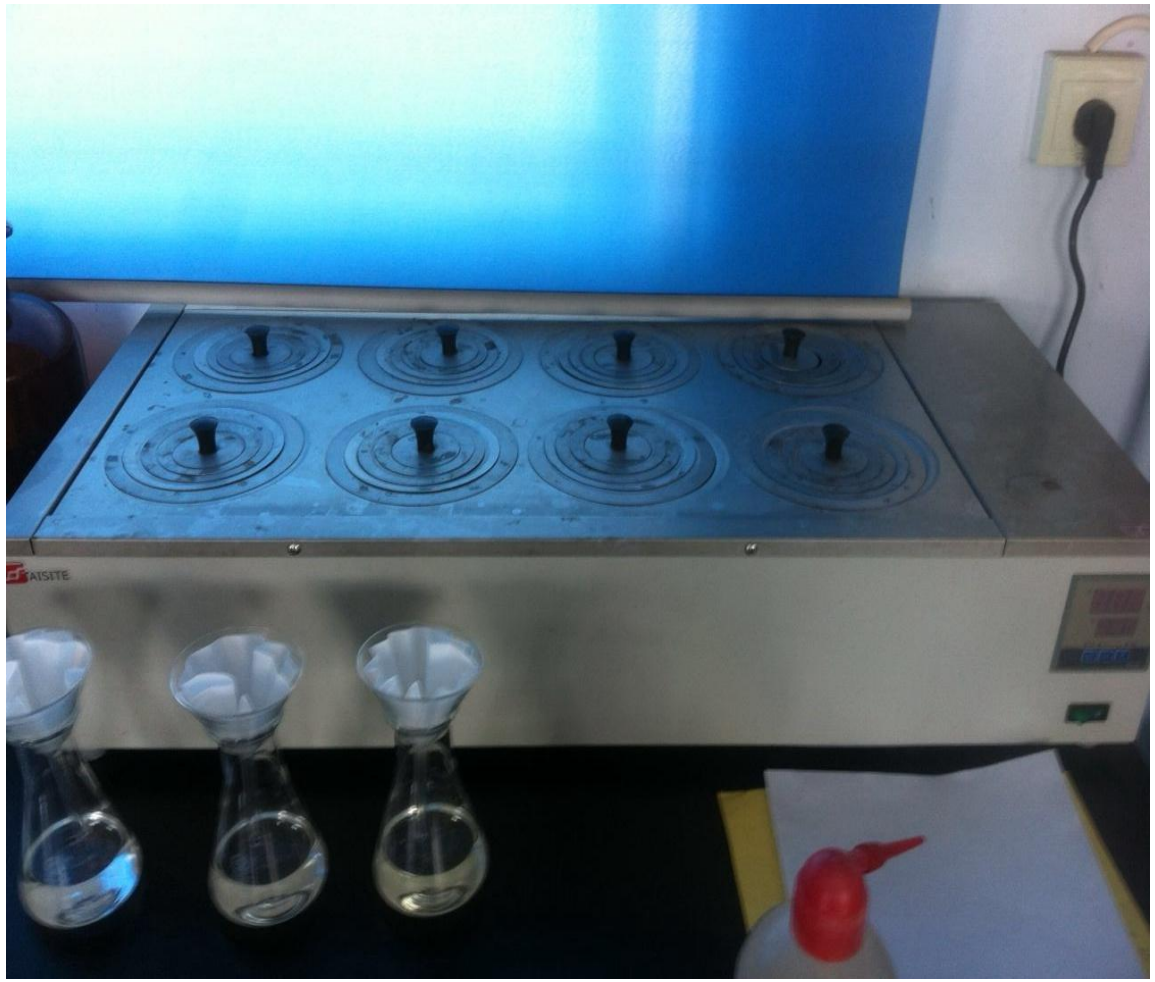
The analysis equipment for TN,the installed place need electricity and tape water.

Spectrophotometer is for detecting the phosphorus in the substrate, the installed place need dry, wind shelter, stable place.

Flame Photometer is the equipment to detect the Potassium elements contents in the substrate,installed place need dry, wind shelter, stable place.



pH meter to detect the pH data.



Water bath tube is for analysis organics contents, suggest use distilling water only.

Atomic absorption spectrophotometer is using for analysis the heavy metal in the substrate, installed place need dry, wind shelter, stable place.

1.Determination of Organic contents - potassium dichromate volumetric method (refer NY525-2012 Standard)

Take certain amount of potassium dichromate – sulfuric acid solution, under boiling water bath, oxidaze the organic carbon in the organic fertilizer,the extra potassium dichromate titration with ferrous sulfate, according to before and after oxidation oxidants (potassium dichromate) the amount of digestion, to determine the carbon contents, then multiplied by a coefficient 1.724, is the organic matter content.

The total organics contents in Fertilizer takes the fertilizer quantity as fraction number, calculated as below formula

有机质含量以肥料的质量分数表示，按式(2)计算：

$$\omega(\%) = \frac{c(V_0 - V) \times 0.003 \times 100 \times 1.5 \times 1.724 \times D}{m(1 - X_0)} \quad \cdots\cdots (2)$$

式中：

c——标定标准溶液的摩尔浓度，单位为摩尔每升(mol/L)；

C-Calibration standard solution concentration, the units is (mol/ L).

V_0——空白试验时，消耗标定标准溶液的体积，单位为毫升(mL)；

Vo-In blank trial, the consuming volume of the calibration standard solution, the unit is (ml).

V——样品测定时，消耗标定标准溶液的体积，单位为毫升(mL)；

V-In sample testing, the consuming volume of the calibration standard solution, the unit is (ml).

0.003——四分之一碳原子的摩尔质量，单位为克每摩尔(g/mol)；

0.003-A quarter of the molar quantity of carbon atoms, the unit is (g/ mol).

1.724——由有机碳换算为有机质的系数；

1.724- The calculation coefficient from organic carbon to organics matters.

1.5——氧化校正系数；

1.5- The Oxidation Correction calculation coefficient .

m——风干样质量，单位为克(g)；

m- The Air-dried sample weight it unit is (g)

X_0——风干样含水量；

Xo- The Air-dried sample water contents (g)

D——分取倍数，定容体积/分取体积，250/50。

D- Dispensing multiple, Fixing Volume/ Dispending volumer-250/50

Organic mater （Volume method）								
Sample name	Sample quantity	Fixing volume	Draw fluid volume	Consumption of standard solution volume	Blank volume	Standard solution concentration	Water contents ratio	Testing data
Ren Ruan organic fertilizer	0.1021	250	50	37.1	41.4	0.19230769	0.1121	35.383036
2		250	50					
3	0.1048	250	50	10.8	14.4	0.20833333	0.1021371	41.223843
4	0.1056	250	50	9.3	14.4	0.20833333	0.0849527	56.869576
5	0.1014	250	50	13	15.8	0.18939394	0.0620152	28.83692
6	0.1024	250	50	13.4	15.8	0.18939394	0.1035553	25.610166
7	0.1039	250	50	12.2	15.8	0.18939394	0.1035553	37.860649
8	0.1164	250	50	11.5	15.8	0.18939394	0.012271	36.635511

2.The Determination of total nitrogen contents-the Kjeldahl Nitrogen Determination method—— (refers NY525-2012 Standard)

The organic nitrogen in fertilizer after boiled by sulfuric acid – hydrogen peroxide Digestion, converted to ammonium nitrogen. After alkalization,the distilled ammonia solution to absorbed by boric acid, titration by acid standard solution , determine the total nitrogen content of the sample

肥料的总氮含量以肥料的质量分数表示，按式(3)计算。

$$N(\%) = \frac{c(V - V_0) \times 0.014 \times D \times 100}{m(1 - X_0)} \quad \cdots\cdots (3)$$

式中：

c——标定标准溶液的摩尔浓度，单位为摩尔每升(mol/L)；

V_0——空白试验时，消耗标定标准溶液的体积，单位为毫升(mL)；

V——样品测定时，消耗标定标准溶液的体积，单位为毫升(mL)；

0.014——氮的摩尔质量，单位为克每摩尔(g/mol)；

m——风干样质量，单位为克(g)；

X_0——风干样含水量；

D——分取倍数，定容体积/分取体积，100/50。

所得结果应表示至两位小数。

The total Nitrogen contents in Fertilizer takes the fertilizer quantity as fraction number, calculated as below formula

C-Calibration standard solution concentration, the units is (mol/ L).

Vo-In blank trial, the consuming volume of the calibration standard solution, the unit is (ml).

V-In sample testing, the consuming volume of the calibration standard solution, the unit is (ml).

0.014- The molar mass of the Nitrogen, the unit is (g/ mol).

m- The Air-dried sample weight it unit is (g)

Xo- The Air-dried sample water contents (g)

D- Dispensing multiple, Fixing Volume/ Di-spending volumer-100/50

The result should be keep two decimal places

Total Nitrogen (the Kjeldahl method							
Sample name	Sample quantity	The trialed solution consumed volume	The blank consumed volume	Acid Standard Solution Concentration	Dilution times	Water contents	Determine data
Organic fertilizer	0.5006	4.25	0.05	0.04895	2	0.1121	1.2951054
Swine dung				0.04895	2		2.8964348
Fermentation material	0.5008	1.6	0.1	0.04895	2	0.1021371	2.2861127
Jing An	0.5003	1.05	0.1	0.04895	2	0.0849527	1.4221005
Biogas	0.5009	0.95	0.1	0.04895	2	0.06201521	1.2398034
Fermentation culture	0.507	1	0.1	0.04895	2	0.10928428	1.3657656
Ren Yuan	0.5033	0.65	0.1	0.04895	2	0.03920066	0.779442
X Brand organic fertilizer	0.5017	1.15	0.1	0.04895	2	0.03920066	1.4927711

3.The Determination of total phosphorus contents-Vanadium-ammonium Molybdate Colorimetrymethod— (refers NY525-2012 Standard)

The total Phosphorus in the organic fertilizer after boiling by H_2SO_4-H_2O_2 (Hydrogen peroxide)，Till （PO_4^{3-}）Phosphate ions in the trialed in the solution formed yellow ternary heteropoly acid with Metavanadic Acid and Molybdic Acid，the yellow solution Absorbent)was directly proportional relationship with P contents .

The total phosphorus contents in fertilizer takes the fertilizer quantity as fraction number, calculated as below formula

肥料的磷含量以肥料的质量分数表示，按式(4)计算：

$$P_2O_5(\%) = \frac{c_2 \times V_3 \times D \times 2.29 \times 0.0001}{m(1-X_0)} \quad \cdots\cdots (4)$$

式中：

c_2——由校准曲线查得或由回归方程求得显色液磷浓度，单位为微克每毫升(μg/mL)；

V_3——显色体积，50 mL；

D——分取倍数，定容体积/分取体积，100/5 或 100/10；

m——风干样质量，单位为克(g)；

X_0——风干样含水量；

2.29——将磷(P)换算成五氧化二磷(P_2O_5)的因数；

0.000 1——将 μg/g 换算为质量分数的因数。

所得结果应表示至两位小数。

C_2-From the calibration curve or from the regression equation to get the Color liquid phosphorus concentration ,the unit is (ug/ mL).

V_3-Colored volume ,50mL

D- Dilution times, fixing volume/ dilution volume 100/5 or 100/10

m- The Air-dried sample weight it unit is (g)

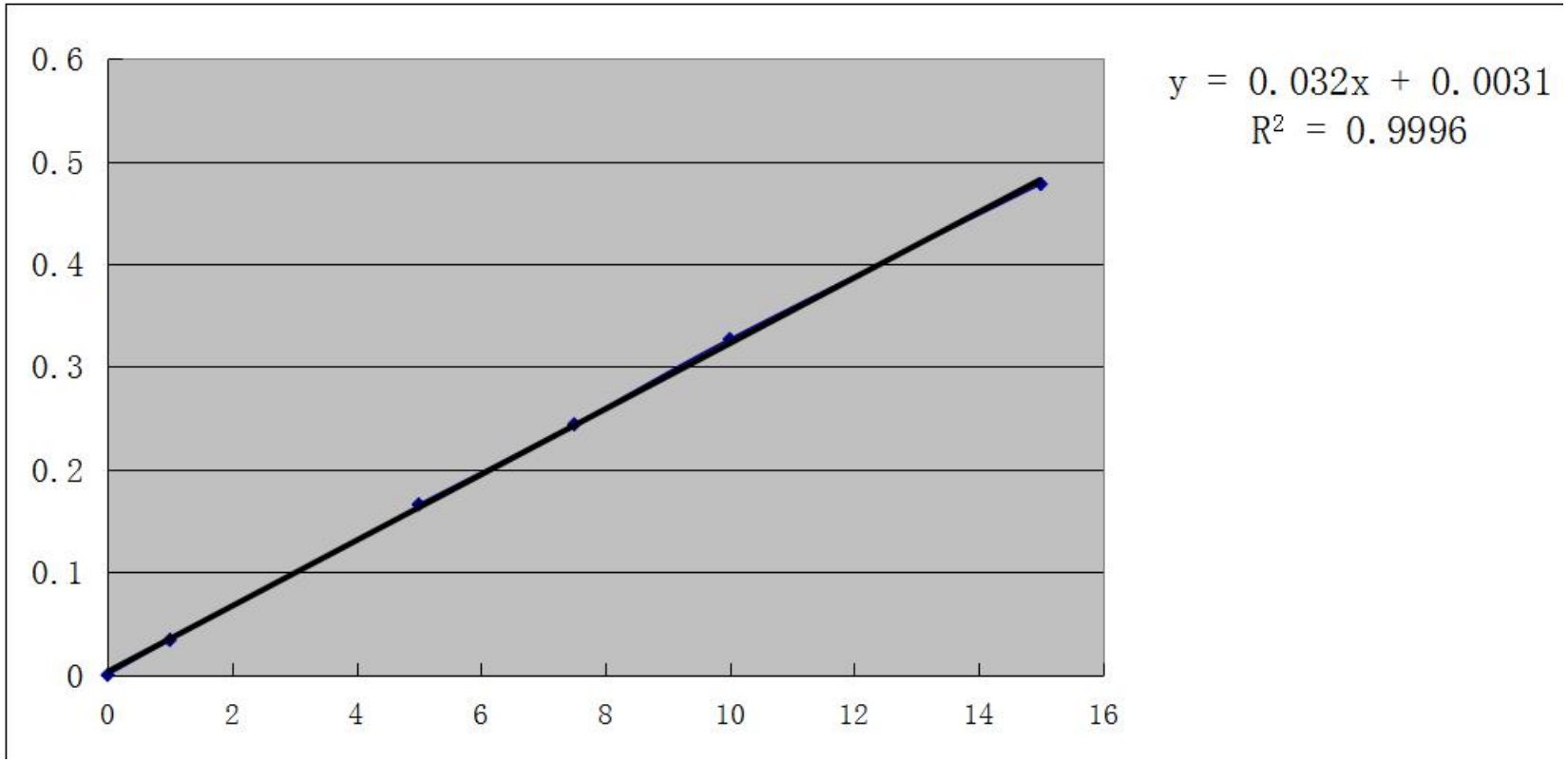
Xo- The Air-dried sample water contents (g)

2.29- The factor to convert the P to P_2O_5.

0.0001- The factor to convert ug/g to quantity fraction.

The result should be keep two decimal places

The standard curve concentration	Absorbent
0	0
1	0.034
2.5	0.078
5	0.166
7.5	0.244
10	0.327
15	0.478



Total phosphorus (UV-Vis spectrophotometry)							
Sample	Sample quantity	Color liquid volume	Dilution times	Absorbency	Relative contents	Water contents	Determine data
Sludge	0.5006	50	20	0.142	4.3468632	0.1121	2.2395283
Sludge		50	20		9.7898729		4.6939966
Sine dung	0.5008	50	20	0.339	10.509351	0.1021371	5.352258
Fermentation substrate	0.5003	50	20	0.164	5.0350598	0.0849527	2.5186398
bio gas	0.5009	50	20	0.255	7.8816913	0.06201521	3.841564
Fermentation substrate	0.5048	50	20	0.117	3.5648216	0.03920066	1.6831438
Ren yuan	0.5113	50	20	0.113	3.4396949	0.03920066	1.6034186
Rand X organic fertilizer	0.5005	50	20	0.156	4.7848065	0.05667564	2.320784

4、The Determination of total Potassium contents——Molybdate flame photometry(refers NY525-2012 Standard)

The total Potassium in the organic fertilizer after degrading by H_2SO_4 -H_2O_2 ， dilution and apply molybdate flame photometry to analysis, in certain concentration range, the proportional relation of K Solution concentration and intensity of emission .

肥料的钾含量以肥料的质量分数表示，按式(5)计算：

The total Potassium contents in fertilizer takes the fertilizer quantity as fraction number, calculated as below formula

$$K_2O(\%) = \frac{c_3 \times V_4 \times D \times 1.20 \times 0.0001}{m(1-X_0)} \quad \cdots\cdots (5)$$

式中：

c_3——由校准曲线查得或由回归方程求得测定液钾浓度，单位为微克每毫升(μg/mL)；

C_2-From the calibration curve or from the regression equation to get the Color liquid Potassium concentration ,the unit is (ug/ mL).

V_4——测定体积，本操作为 50 mL；

V_4-Testing volum, this operation is 50mL

D——分取倍数，定容体积/分取体积，100/5；

D- Dilution times, fixing volume/ dilution volume 100/5 ;

m——风干样质量，单位为克(g)；

m- The Air-dried sample weight it unit is (g)

X_0——风干样含水量；

Xo- The Air-dried sample water contents (g)

1.20——将钾(K)换算成氧化钾(K_2O)的因数；

1.20- The factor to convert the K to (P_2O).

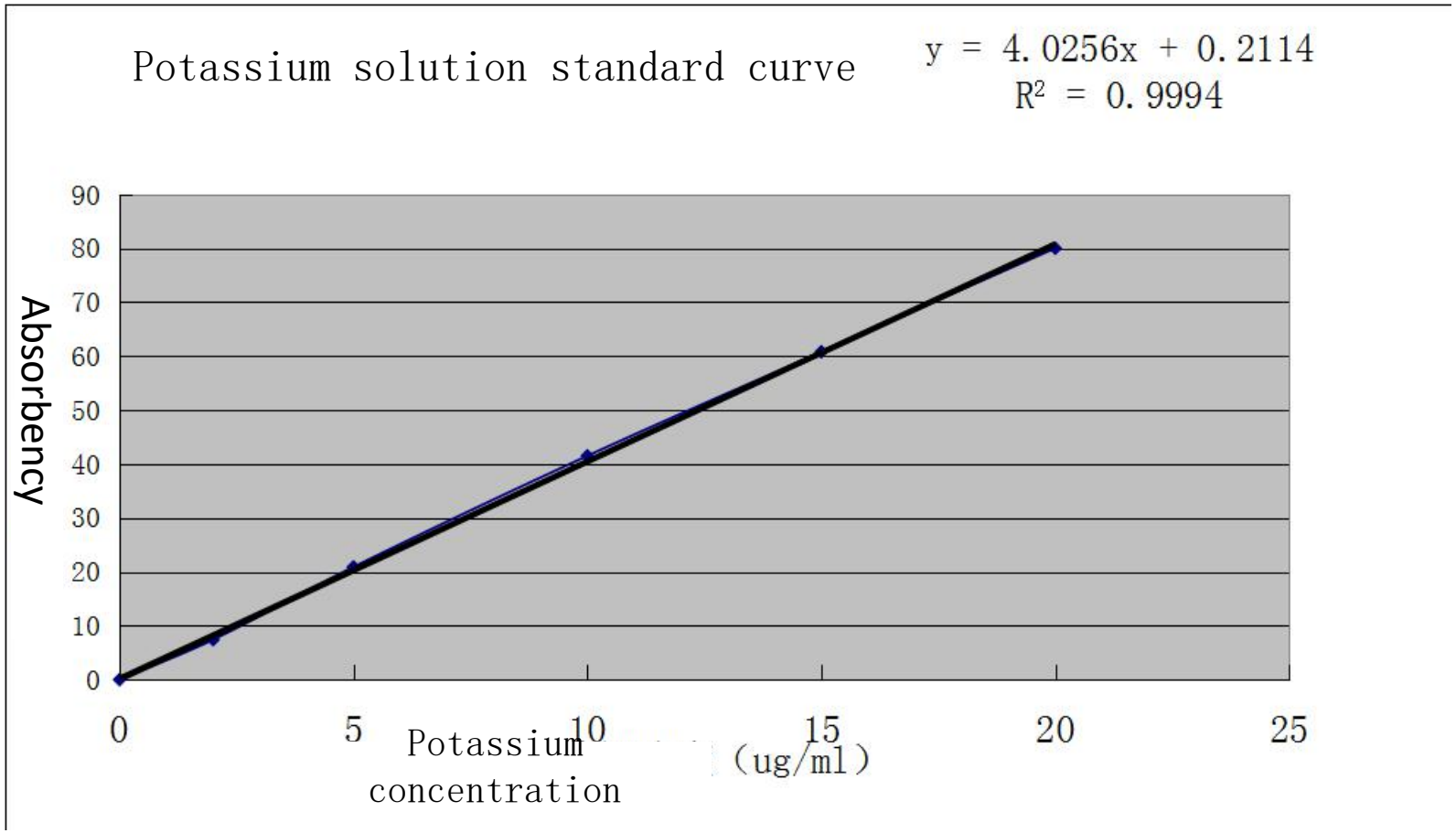
0.0001——将 μg/g 换算为质量分数的因数。

0.0001- The factor to convert ug/g to quantity fraction.

所得结果应表示至两位小数。

The result should be keep two decimal places

Standard curve concentration	Absorbency
0	0
2	7.4
5	20.9
10	41.5
15	60.8
20	80

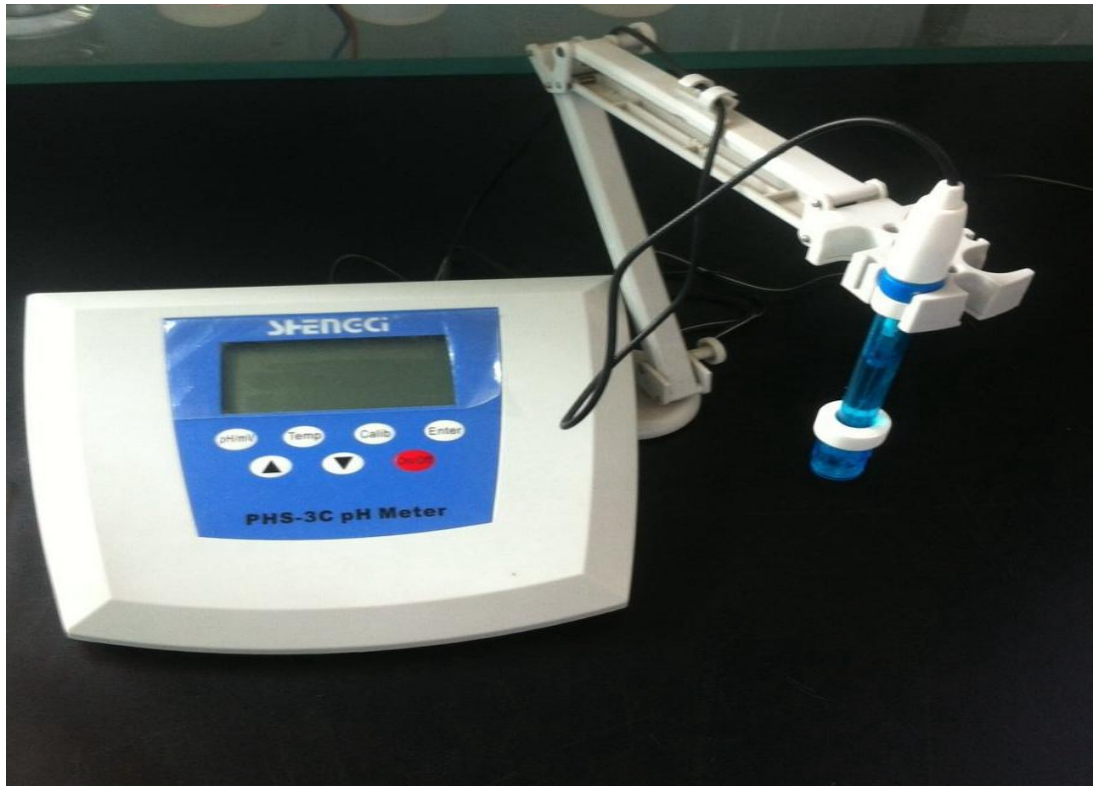


	Absorbency	Concentration（ug/ml）	Testing volume（ml）	Dilution times	Air dry sample（g）	The Air-dried sample water contents（%）	K Convert to (P_2O)	Quantity Factor score	Percentage contents
Sample1	26.1	6.4322205	50	20	0.5006	0.1121	1.2	0.0001	1.7365499
Sample2		6.040051	50	20			1.2	0.0001	1.6106803
Sample3	36.4	8.838806	50	20	0.5	0.1	1.2	0.0001	2.357015
Sample4	39.5	9.4762028	50	20	0.5	0.1	1.2	0.0001	2.5269874

5. The water content determine—Vacuum oven method (refers NY525-2012 Standard)

Sample name	No.	Quality weighing bottle	Weight before dry	Weight after dry	Water content
Organic fertilizer	1	12.3153	17.3183	16.7573	11.213272
Sludge	2				
Organic fertilizer	3	18.9792	23.9998	21.1875	56.0152173
Swine dung	4	19.2508	24.263	23.8372	8.49527154
Organic fertilizer	5	12.0714	17.0859	15.8918	23.8129425
Divine farmer	6	22.0314	27.2471	25.7305	29.0775927
Organic fertilizer	7	19.2566	24.3376	22.8431	29.4135013
Divine farmer	8	21.6742	26.5658	26.1382	8.74151607
	9	17.1816	22.4388	21.984	8.65099292

6.pH meter —pH PH meter method (refers NY525-2012 Standard)



Sector 4 The commen practice to judge the organic fertilizer quality

4 Four

Physical indicators：

Smell： No stink，has certain fermentation fragrance.

Color：Brown, dark brown

Appearance：Uniform, without mechanical impurities.

Che indicator：

Organic substance≥45%、N+P+K≥5%，Water≤30%，pH 5.5-8.5。

Biological indicator：

E.Coli account ≤100/g
Ascaris eggs mortality, % ≥95。

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From how to treat manure,
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Thank you!