

KENYA STANDARD

KS 2528:2014

Blending fertilizers- code of practice

DRAFT STANDARD FEBRUARY 2014

© KEBS 2014

First Edition

TECHNICAL COMMITTEE REPRESENTATION

The following organizations were represented on the Technical committee:

Ministry of Agriculture
Government Chemist department
Mea Ltd.
Chemagro Ltd
Kenya Plant Health Inspectorate Service (KEPHIS)
Tea Research Foundation of Kenya
Athi River Mining Ltd-Mavuno fertilizers
Osho chemicals Ltd
Consumer Information Network
Yara East Africa Ltd
Kel Chemicals Ltd.
Kenya Tea Development Agency
Horticultural crops Development Authority
Amiran (K) LTD
Kenya Bureau of Standards — Secretariat

REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

© Kenya Bureau of standards, 2014

Copyright: Users are reminded that by virtue of Section 6 of the Copyright Act, Cap. 130 of the Laws of Kenya, copyright subsists in all Kenya Standards and except as provided under Section 7 of this Act, no Kenya Standard may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from the Managing Director.

Blending fertilizers- code of practice

KENYA BUREAU OF STANDARDS (KEBS)

Head Office: P.O. Box 54974, Nairobi-00200, Tel.: (+254 020) 605490, 602350, Fax: (+254 020) 604031
E-Mail: info@kebs.org, Web:<http://www.kebs.org>

Coast Region

P.O. Box 99376, Mombasa-80100
Tel.: (+254 041) 229563, 230939/40
Fax: (+254 041) 229448

Lake Region

P.O. Box 2949, Kisumu-40100
Tel.: (+254 057) 23549, 22396
Fax: (+254 057) 21814

Rift Valley Region

P.O. Box 2138, Nakuru-20100
Tel.: (+254 051) 210553, 210555

Foreword

A quality bulk blended, solid fertilizer is a uniform product made by mechanically mixing, in suitable equipment, two or more granular materials having known nutrient content and which are closely matched in particle size.

The producer and/or seller of materials used in blends and the operators of blend plants share a responsibility for producing quality blends.

The producer has the responsibility for providing blending plants with properly sized materials of guaranteed nutrient content. The blender has the responsibility for not only having good, well maintained blending equipment, but good procedures for operating it and for determining if the materials he receives are suitable for blending.

A large number of blended fertilizers are produced from basic primary fertilizer products (e. g ammonium nitrate, urea and mono-ammonium phosphate) and natural materials (e.g. rock phosphate, potassium chloride).

Custom blends allow fertilizers to be ordered tailored to individual crop or region specific needs.

Mistakes, however, can be made in formulating custom Blends, which may lead to application difficulties or crop not meeting expectations.

This may result from using ingredients that have limited compatibility. As a consequence, the blend deteriorates in storage and is difficult to apply.

Problems may also arise if ingredients are added at an inappropriate rate, either too low (leaving an uncorrected deficiency) or too high (inducing toxicity or nutrient imbalances).

it is also possible that there will be nothing wrong with the formulation, but the advice on when, how and at what rate it should be applied is incomplete or erroneous.

During the preparation of this code of practice in blending fertilizers, reference was made to the following

1. European fertilizer blenders association, 2005(2nd Ed): Handbook of solid fertilizer blending: Code of good practice for quality
2. The fertilizer institute,2010:Bulk blend Quality control manual
3. Incitec pivot,2012:Custom blends guidance notes
4. European fertilizer manufacturer's association (EFMA), 2006: Guidance for the compatibility of fertilizer blending materials.

The assistance derived from the above sources is hereby acknowledged with thanks.

1.0. Scope

This Kenya Standard code of practice describes the accepted practices in the blending of fertilizers.

1.1. Definitions

1.1.1 blendend fertilizer

Fertilizer obtained by dry physical blending of various raw fertilizers, without any chemical reaction.

1.1.2. Complex fertilizer

Compound fertilizer obtained by chemical reaction, by liquid solution or in the solid state, by granulation and having a declarable content of at least two of the major nutrients.

1.1.3. Compound fertilizer

Fertilizer having a declarable content of at least two of the nutrients nitrogen, phosphorous and potassium, obtained chemically or by blending, or both

1.1.4. d_{50} (Mean particle size): that size such that half the particles, by mass, are larger than that size and half are smaller.

1.1.5. Granular fertilizer

Solid fertilizer formed into particles of a predetermined mean size by granulation.

1.1.6. Granulation.

Technique using processes such as agglomeration, accretion or compaction to modify the particle size.

1.1.7. Granulometric spread index (GSI)

Measure of the spread of particle sizes and a means of expressing the granulometric spread.

1.1.8. Increment: Representative quantity of material taken from a sampling Unit.

1.1.9. Lot

Total quantity of material, assumed to have the same characteristics, to be sampled using a particular sampling plan.

1.1.10. Particle size

Dimension which corresponds to the smallest sieve aperture size through which a particle will pass if presented in the most favourable attitude.

1.1.11. Particle size analysis by sieving

Division of a sample by sieving into size fractions.

1.1.12. Raw material

Solid, granular material used as a component in a blended fertilizer

1.1.13. Segregation

Differential movement of particles within a mixture due to differences in their size, shape or density, resulting in their separation.

1.1.14. Sieving.

Process of separating a mixture of particles according to their sizes by one or more sieves

1.1.15 **Size guide number (SGN):** 100 times the d_{50} Measured in millimetres

1.1.16. **Spreading width:** Distance between the extreme left and right points where the fertilizer arrives on ground.

1.1.17. **Straight fertilizer**

Qualification generally given to nitrogenous, phosphatic or potassic fertilizer having a declarable content of only one of the plant nutrients nitrogen, phosphorous or potassium.

1.1.18. **Test sieving:**

Sieving with one or more test sieves

1.1.19. **Working width:**

Distance between each +passage (generally between 12 and 48 m) when spreading fertilizers.

2.0. Selection of materials

The first step in making a quality blend is to select materials with known chemical analysis and which are closely matched in particle size.

2.0.1 Chemical analysis (nutrient content)

The blending plant formulator shall know the nutrient content of each material used if they are to make blends containing the expected amounts of nutrients.

2.1. **Particle size.**

2.1.1. Blend ingredients shall be uniform and evenly matched in sizing to minimize segregation. Powders, dusts, and fine crystalline ingredients shall not be used as except as provided in clause 8.6

2.1.2. Insoluble fertilizers and micronutrients or trace elements shall have a fine particle size to be effective

3.0. Calculating formulas

Calculating formulas is an essential part of producing quality products.

3.1. Grade formulas- the nutrients are expressed as percentage of the total weight

3.2. Soil test formulas -the nutrient contents are calculated so that the blend produced will supply a certain amount of nutrients per acre when applied at a given rate. Also called custom blend formulas.

4.0. Price.

Where possible high analysis fertilizers shall be used as ingredients for blends. A high analysis allows appreciable savings to be made in freight, handling and packing charges.

4.1 Crop quality and safety

Materials for fertilizer blends shall not be harmful to crops and shall not have any effect on the overall quality of the produce.

4.2. Sizing (physical compatibility)

2.2.1 Blend ingredients shall be uniform and evenly matched in sizing to minimize segregation. Powders, dusts, and fine crystalline ingredients shall not be used.

2.2.2. Insoluble fertilizers and micronutrients or trace elements must have a fine particle size to be effective.

4.3. Critical relative humidity

The choice of blend ingredients shall be such that the final critical relative humidity shall be as high as possible

4.4 Chemical compatibility

The choice of Ingredients used in a fertilizer blend shall be such that they do not react when mixed together as this has effect on quality and storage life of the blend and its ease of application.

5.0. Blending operations

5.1. Minimum additional rates

5.1. The minimum additional rate for major ingredients such as urea, DAP, MAP and muriate of potash, which are fed through the large hoppers shall be 5%.

5.2. For minor ingredients that are fed through the trace element hoppers the range shall be between 2 and 7%.

5.3. The minimum addition rate for ingredients fed through the small hoppers shall be 1%. Except for kieserite, for which the minimum concentration shall be 3.5%

5.2.0. Maximum additional rates

5.3.1. Maximum concentrations

5.3.1 The maximum additional rates for ingredients fed through the small hoppers, e.g trace elements and specialty fertilizers the maximum limit shall be 20%. For most major ingredients such urea, DAP, MAP, and muriate of potash, no limits apply. These ingredients are fed through the large hoppers on the volumetric (screw) blenders.

5.3.2. Lower limits may apply to some products, after consideration has been given to

- i) Security, occupational health and safety, and operational issues
- ii) Whether the blend is classified as a dangerous good, Hazardous chemical/substance or poison, the likely demand, and does this justify making specific safety data sheets (SDS) available.

6.0. Safety Data sheets

- i) It is a legal requirement safety data sheets be available for any product that is classified as a dangerous good and/or hazardous.
- ii) The SDS must be made available when the product is supplied for the first time, at the time it is re-supplied should any changes be made to the SDS, and on request.
- iii) SDS must specify those ingredients that are deemed to make the blend a dangerous good, Hazardous or poison.

6.1. Security

Fertilizers containing more than 45 % ammonium nitrate are classified as security sensitive Ammonium Nitrate (SSAN)

6.2. Occupational health and safety.

The maximum concentrations of sulphur bentonite and magnesium oxide in blends shall be 20% and 10% respectively for occupational health and safety reasons.

6.3. Dangerous goods, Hazardous chemicals and poisons

Some blend ingredients are classified as being a Dangerous good, Hazardous and/or as a poison. Above certain concentrations, blends in which they are used will also be treated the same. The concentrations at which these classifications take effect shall be used as maximum concentrations in blends.

6.4. Marine pollutants

- i) Copper granulates, Manganese sulphate and zinc sulphate monohydrate are classified as marine pollutants under the criteria of the International Maritime Dangerous Goods (IMDG) code.
- ii) Blends containing 1% manganese sulphate Granular or Zinc sulphate monohydrate or 2% copper granules, are also classified as Marine pollutants.

If transported by sea, these blends must be shipped as environmentally hazardous substance.

7.0. Plant and equipment design

The design of the plant and equipment shall be such that it ensures the following.

- i) Minimal segregation of materials
- ii) Cross contamination of materials is avoided
- iii) Materials remain in good physical condition during handling and storage
- iv) Blended materials do not segregate during handling
- v) Environmental regulations are met.

7.1 plant design

There are two designs

- a) Horizontal design/open bin layout**
- b) vertical design**

7.1.1. Site selection

Factors to take into consideration include

- i) The available land area and access to the site.
- ii) rail and/or truck delivery of materials
- iii) Routing of transport vehicles into and out of the site.
- iv) location of other facilities and buildings on site
- v) Environmental impact assessment
- vi) Socio-economic considerations

7.1.2. Construction factors

These include:

- i) Tonnage capacity of the facility shall meet the needs of the sales area.
- ii) Bins of adequate size shall be provided for each fertilizer material used
- iii) Bulkheads and walls shall be constructed to withstand lateral pressure of stored materials
- iv).Aisle width shall be sufficient for equipment traffic
- v) Wiring and electrical equipment shall be properly grounded and designed to withstand to withstand the corrosive environment of a fertilizer facility
- vi) Receiving, blending and shipping equipment shall be designed for the space available and the tonnage capacity of the plant.
- vii) Safety and environmental factors shall be considered and addressed in all phases of construction.

7.1.3. Materials of construction

The size of the plant and the basic design will largely determine the choice of the construction materials. Some of the choices include:

- i) Reinforced concrete, which has the advantage of long life and fire safety
- ii) Structural steel framing with corrosion resistant coating.
- iii) Plastic or corrosion resistant metal roofing and siding material
- iv). Wood roofing, siding and framing material.

7.2. Equipment design

All equipment shall be selected and designed to minimize segregation, degradation, and spillage of all materials

7.2.1. Receiving equipment

Conveyers are best suited for receiving and storing fertilizer materials. Auger and elevator systems can be used but care must be taken to operate these systems properly to avoid material degradation. Some available systems are:

- i) Rubber troughed belt conveyors with either smooth or cleated surface which moves the material at high speeds from the unloading pit
 - ii) Mesh chain conveyors which slide over a metal plate surface
 - iii) Auger systems which are operated at design capacity
 - iv) Elevators which are essentially vertical conveyors.
- d) Chain type-centrifugal discharge B

7.2.2. Storage distribution system

- i) Materials can be distributed to their respective storage bins using trip belt, auger or elevator and leg systems
- ii) Anti-segregation systems such as spinners and flow splitters shall be installed.
- iii) All systems shall be designed to avoid cross-contamination of materials during handling.

7.2.3. Weighing equipment

Weigh hoppers of various designs are available. Size and type can be chosen based on plant size and tonnage requirement. Hoppers can be equipped with either electronic-digital readout or dial heads.

7.2.4. Dry fertilizer mixers

Because of the large number of designs in use, consideration shall be given to the special features of each to obtain the best design for each individual plant. The following types are available.

- i) Cone end tilted axis
- ii) Rotating tub
- iii) Stationary tab mixer
- iv) Vertical mixer
- v) Volumetric mixer

7.2.5. Loading equipment

This may include hoppers that receive blended product for either bulk-loading or bagging.

7.2.5.1. The blended material can also be loaded directly using a conveyor belt system. All load-out equipment shall be constructed to minimize segregation.

7.2.5.2. For hoppers internal “egg crate” baffles are effective in square or rectangular designs.

7.2.5.3. A concentric-cone distributor is beneficial in cylindrical hoppers.

7.2.5.4. Direct load out systems can utilize a flexible spout to distribute the blended material evenly throughout the receiving vehicle. Some design criteria for hopper construction to be met include:

- i) Cone bottoms shall be steep enough to permit easy, uniform exit flow
- ii) Pyramid bottoms shall have sides that are sloped steeply enough so that valley angles are at 50% or more to 5th the horizontal
- iii) The incoming flow of blended material shall be centered at the top of the hopper and discharged straight down.

8.0. Plant operations and housekeeping

8.1. Receiving materials

- i) Rail cars and trucks bringing materials into the plant shall be inspected before unloading
- ii) One shall visually compare the product with the bill of lading to make sure that they are receiving the correct product
- iii) Questionable materials shall never be put into a bin which already contains product
- iv) Before unloading one shall make sure that the equipment to be used and the storage area is clean and dry.
- v) If necessary any material that could contaminate the product shall be removed.
- vi) The equipment shall be checked to make sure it is set to deliver to the proper bin
 - viii) One shall make sure that there is enough room in the receiving bin to hold all the material to be received and that there are no leaks and no spillage is occurring.
 - ix) Bins shall always be properly and legibly labelled.
 - x) occasional sampling of materials shall be done to check for analysis and/or particle size

8.2. Material storage and reclaim

Materials shall be handled in such a manner to prevent formation of conical piles

8.3. Weighing

Scales shall be checked at frequent intervals throughout the entire range they are used

8.4. Mixing/blending

The mixture shall have the ability to discharge the mixture without causing it to un-mix.

8.5. Shipping

- i) Where possible finished blends shall be shipped in bulk immediately or they shall be bagged.
- ii) The mixer and the shipping operation shall be located in close proximity to one another
- iii) When it is necessary to transport blends a long way over some type of conveyor a mixing baffle shall be installed at the discharge end in recombining the product dispersed by vibrations
- iv) Any discharge belts shall be in good shape and have good cleats. Poor cleats may allow the material to segregate as the belt moves by allowing the smaller material to move more rapidly than the larger material. Poor cleats will also cause the material not to move evenly on the belt and can un-mix the blend.
- v) If the product is discharged into a holding hopper over either a bulk load out or a bagger, the hopper shall be equipped with ant segregation dividers
- vi) If the product is to be bagged, the bagging equipment shall be checked for cleanliness and be verified whether it is set to deliver the correct weight for the grade that will be bagged.
- vii) Periodic samples shall be taken of finished products with some frequency for assurance that quality products are being produced.

8.6. Secondary and micro nutrients

- if) If a minor nutrient carrier comprises 5% or more of the formula weight, it shall be used as granular material in size comparable to that of the major nutrient materials. When the minor nutrient additive represents less than 5% of the formula weight, it is recommended that a powdered material be used
- ii) Good homogeneity can be obtained when a liquid binder is used to adhere to the powdered minor ingredient to the surface of the major nutrient particles.

8.7 pesticides

- i) It is strongly recommended that separate blending systems be used for pesticides and herbicides. Where it is not possible it is very essential that every precaution be taken to prevent contamination from batch.
- ii) It is recommended that granular forms of pesticides shall not be used in blends. This is because particle size and density are seldom similar and segregation will result.
- iii) The mixture should always be completely cleaned after running a pesticide mix. Also great care needs to be taken to prevent carryover of one chemical, say

for a broad leaf weed control, into a product used for a crop sensitive to this particular chemical.

iv) Very careful segregation of the weed killer products throughout their storage, handling, and use in the blend and in subsequent application procedures is essential

8.8. Records and Batch sheets

Batch sheets/blending formula records, tally sheets, batch tickets are essential records as to the materials used and the quantity of each material in the batch. This is often the only proof that the plant operator has as to what was supplied to the customer. These records are valuable for inventory, trouble shooting a complaint and verifying to a grower that he received the materials for which he was invoiced.

8.9. House keeping

- i) After all plant operations it is important to clean the equipment and sweep up spills'
 - ii) In plants with overhead belts, these shall be well maintained to minimize spillage into bins and driveways over which they pass.
 - iii) contamination shall always be avoided as it is the frequent cause of off-grades
 - iv) bins shall not be left to leak into one another, either through openings in the walls or by product running out the open fronts of adjacent bins
 - v) if there are cluster hoppers they should not be left to run over into one another at the top. The gates should not leak
 - vi) all bins shall be correctly labelled
 - vii) as much as possible try to confine spillage to the area in front of the bin so that it can be easily scraped or swept back into the bin.
 - viii) driveways shall be kept free of fertilizer, foreign material, and moisture
- Dust should be avoided to accumulate either in the building or on the equipment. It will absorb moisture much more rapidly than the granular materials, accelerate corrosion, cause slippery conditions, and generally contribute to an overall sloppy appearance.

ANNEX B (INFORMATIVE)

Common blending materials

Name	Abbr	Formula	N	P ₂ O ₅	K ₂ O	SO ₃	MgO
Ammonium Nitrate	AN	NH ₄ NO ₃	33-34.5				
Calcium Ammonium Nitrate	CAN	CaCO ₃ /NH ₄ NO ₃	26-28				
Ammonium Sulphate Nitrate	ASN	(NH ₄) ₂ SO ₄ /NH ₄ NO ₃	26			35	
Ammonium Sulphate	AS	(NH ₄) ₂ SO ₄	21			60	
Urea		CO(NH ₂) ₂	46				
Superphosphates:							
Single Superphosphate	SSP	Ca(H ₂ PO ₄) ₂ *		18-20		30	
Triple Superphosphate	TSP	Ca(H ₂ PO ₄) ₂ *		45-48		3	
Potassium Chloride	MOP	KCl			60-62		
Potassium Sulphate	SOP	K ₂ SO ₄			50	45	
Korn-Kali®		KCl/MgSO ₄			40	12	6
Potassium-Magnesium Sulphate		K ₂ SO ₄ +MgSO ₄			30	42	10
Ammonium Phosphates:							
Diammonium Phosphate	DAP	(NH ₄) ₂ HPO ₄	18	46-48			
Mono-ammonium Phosphate	MAP	NH ₄ H ₂ PO ₄	12	52-53			
Calcium Carbonate		CaCO ₃					
Compacted Dolomite		CaCO ₃ - MgCO ₃					20
Magnesium Carbonate		MgCO ₃					10
Kieserite		MgSO ₄				50	25-28