TVET CERTIFICATE V in FORESTRY

WOOD CHARCOAL MAKING

FORWC501

Make wood charcoal

Competence

Credits: 5

Learning hours: 50

Sector: Agriculture

Sub-sector: Forestry

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Purpose statement

This module describes the skills and knowledge required to apply improved charcoal making technology. These practices are of great importance for the preservation of fuel wood in Rwanda.

The module will allow the learner to Prepare tools and materials, Conduct carbonization, Harvest wood charcoal and by-products.

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LO 1.1 – Identify tree species for charcoal making

- Topic 1: Suitable trees species for charcoal making

There are two broad types of wood, hardwoods produced by broadleaved species and softwoods produced by conifers. Both produce charcoal but hardwood charcoal is usually stronger than softwood charcoal. Suitable tree species for charcoal making are Myrtaceae family e.g *Eucalyptus saligna* and Mimosaceae family e.g *Acacia* trees.

- Topic 2: Criteria of selecting tree species for wood charcoal making

✓ **Maturity**: The stages in the life cycle of a tree. Young or juvenile trees have not yet reached 1/3 of their expected mature height. They are generally growing vigorously and have high apical dominance. Early-mature trees are between 1/3 and 2/3 of expected mature height. Mature trees are close to their full height and crown size, these dimensions being determined by species and site factors. Over mature trees are not good for charcoal making because their concentration in lignin becomes low as the tree gets older.

✓ **Age:** there is no predetermined age as this is associated with maturity. The age of a tree to mature is to be documented depending on the tree species and site factors. In general, trees for charcoal making are harvested between 12-15 years.

✓ **Size:** varies according to the species and should be checked from tree phenology.

✓ **Purpose/end use of charcoal:** whether is for household use or sale.

✓ **Hardwood:** Also known as "lump charcoal," this is what you get when wood is burned down to an impurity-free coal. No binders, no fillers – just pure, simple, high-quality charcoal.

✓ **Calorific value:** Calorific value is the amount of heat produced by the complete combustion of a fuel. The calorific value for wood ranges from 3.5 to 5 kilojoules per gram (kj/g) and for charcoal it ranges between 5 to 9 kj/g. The value is used to determine the efficiency and effectiveness of different types of fuels. Calorific value is measured in units of energy per quantity of fuel, e.g. kg/g, while density of wood is the weight of wood per volume, e.g. grams per cubic metre (g/cm3).

Calorific value of wood and charcoal from selected tree species			
Species	***Density of the wood (g/cm^3)***	***Calorific value of wood (kj/g)***	***Calorific value of charcoal (kj/g)***
Acacia mearnsii	0.775	3.7	7.4
Casuarina equisetifolia	0.820	5.0	7.7
Eucalyptus grandis	0.790	4.5	7.5
Eucalyptus maculata	0.603	–	7.4

LO 1.2 – Select tools, materials and equipment

- Topic 1: Types of tools, materials and equipment used in charcoal making

These include: hand hoe, shovel, machete, slasher, pegs, ropes, axe, chainsaw, two-man saw, wedges, measuring tape, bricks, chimney, cant hook, metal file, logs, wheelbarrow, bags, machete, twigs, clods and soil. Since you are working with fire, keep a water supply nearby and handy to put out any stray sparks (or cool a burn).

- Topic 2: Criteria of selecting tools, materials and equipment

A range of tools, materials and equipment is used to make charcoal vary mainly depending on the method to use and the quantity needed to produce, the accessibility of the site, skills of charcoal burners, availability of tools and equipment, size of tree species, market, budget.

LO 1.3 – Use tools, equipment and materials

- Topic 1: Manipulation techniques

Tools, equipment and materials should be used according to what they are designed to do. The respect of manufacturer's instruction is worth to keep tools and equipment working longer and efficiently. In case of damage, the tools and equipment should be repaired as soon as possible according to the instruction given in their manuals (catalogue).

- Topic 2: Safety precaution

Things that lead to tools getting damaged are leaving the tools dirty after use, using a particular tool for a wrong purpose, leaving tools to spend nights outside i.e air and moisture make them rust, leaving tools with wooden handles to stay in water for a long time i.e it makes the wooden part rot, failing to add oil or grease to moving parts of machines, for example wheelbarrow. Failing to sharpen cutting tools regularly.

LO 1.4 – Prepare wood for charcoaling

- Topic 1: Logging operations

It is the process of cutting a felled tree and de-limbed tree into logs reserved for charcoal burning. The measures depend on type of method to use.

Bucking comes after debranching. The first operation in bucking is measuring and marking lengths of logs to cut in a precise manner according to the carbonization method to use. Woods are bucked into different

log lengths according to the needed size, generally at the felling place. The work can be completed by axe but saw is more adapted for this operation. Bucking operation demand much care to avoid the following risk:

- ✓ The trunk can move laterally
- ✓ The trunk can start to roll
- ✓ The trunk can suddenly fall on the ground
- ✓ The trunk can split

To prevent accident that can occur, it is important to study the tree condition and suggest reactions it can have during bucking.

Figure 1: Bucking a felled tree with an axe

- Topic 2: Wood drying

The best system is to allow maximum drying to be done as near the stump as practical as this reduces capital tied up in stock and reduces the weight of wood to be transported. In plantations with good access right to the stump the trees are merely felled lying in the one direction and allowed to dry before being crosscut. This may be 3 to 12 months.

It is an important step because upon felling, moisture content is approximately 60 percent. After three

weeks stacking of short blocks it is reduced to 30-35 percent. Loss of weight makes transportation easier and cheaper (e.g.1000 kg green wood with moisture content of 50 percent yields 180 kg of charcoal while only 520 kg dry wood with 15 percent moisture content is required to produce the same amount of charcoal).

Drying is not a mandatory step of drying but is highly recommended as it will reduce carbonization time while saving a lot of energy which would have otherwise been used to dehydrate the wood.

LO 2.1 – Select carbonization method

- Topic 1: Criteria for selection of carbonization method

The selection of carbonization method considers market, topography of the land, quantity to produce, labor and budget.

Market: as the rule of thumb, consumers need the best quality products and these can be obtained according to the method of carbonization used. For example, industries use high calorific value charcoals which are only produced by modern kilns. It is merely linked to the quantity demanded.

Topography: when the site is not accessible, it is difficult to use modern kilns because of problems linked to the transport of tools and equipment.

Labor and **budget**: skills of workers, the cost of tools and equipment to use influence on the selection of carbonization method to put in place.

The choice of carbonization method has to conform to the limitations of the project especially if a relatively short life of enterprise is expected and the cost of labor in the zone has to be taken into account.

- Topic 2: Construction of traditional earth mound kiln

Traditional kilns are characterized as; temporary structures built on the site of wood harvesting. It is constructed easily by using locally materials collected from the harvest site without extra cost and is the most important advantage of earth mound kiln. Kiln building begins with the following process:

- ✓ Site preparation and this depends on site topography
- ✓ Stacking of woods at carbonisation site
- ✓ Cutting woods into reasonable length
- ✓ Lay out of wooden frame on the ground
- ✓ Start stacking with respect of log sizes and closing of voids
- ✓ Leave spaces in bottom sides of kiln to serve as air-inlets and outlets
- ✓ Covered the heap with 15-20 cm thickness layer of grass, and the construction is sealed with 5-10 cm thickness loamy soil.

NB. Thin branches and twigs are not stacked in this process because they have potential to burn and produce flames, so tree trunks and large, thick branches are preferred.

Figure 2: Construction of Earth mound kiln

- Topic 3: Construction of traditional earth pit kiln

Small pits or holes up to a cubic meter or so are useful for producing small amounts of charcoal from small, fairly dry wood. The method is employed at the village level, but is usually too low in productivity to supply large amounts commercially. To burn charcoal this way a fire is first started in the pit and dry small fuel is added to make a strong fire. More wood is added to fill the pit, the fire continuing to burn steadily. A layer of leaves about 20 cm thick is placed over the wood fuel and then earth about 20 cm thick shoveled on. The pit is left to complete carbonization and can be opened in two days or less. Water may be needed to prevent ignition when the pit is unloaded. Charcoal is not uniform in quality and, if small wood and bark is used, the proportion of fines is excessive. Sometimes pits axe covered by a sheet of old roof iron covered with earth, allowing a few small openings for escape of smoke and entry of air. Capital investment is minimal; But the method is wasteful in resource.

- Topic 4: Construction of improved brick kilns

Properly constructed and operated brick kilns are without doubt one of the most effective methods of charcoal production. They have proved themselves over decades of use to be low in capital cost, moderate in labour requirements and capable of giving surprisingly good yields of quality charcoal suitable for all industrial and domestic uses.

The brick kiln must comply with a number of important requirements to be successful: It must be simple to construct, relatively unaffected by thermal stresses in heating up and cooling and strong enough to withstand the mechanical stresses of loading and unloading. It must be unaffected by rain and weather over six to ten years. It must be of reasonably light weight construction to allow cooling to take place fairly easily and yet provide good thermal insulation for the wood undergoing carbonization, otherwise production of cold spots due to wind impact on the kiln walls prevent proper burning of the charcoal and can lead to excessive production of partially carbonized wood pieces ("brands") and low yields.

There are many designs of brick kilns in use throughout the world and most are capable of giving good results. These are Half-orange, Brazilian beehive, Slope type beehive, the Missouri kiln.

The following procedures should be respected during the construction and/or building of half-orange kiln.

- ✓ **Design and construction**: The design of this kiln is shown in figure 5. The kiln is built completely with bricks. Charcoal fines and mud are used as mortar, usually with no iron or steel support at any place. The shape is hemispherical, of a diameter of about 6 m (range 5-7 m). The size of the bricks is 0.24 m x 0.12 m x 0.06 m. To construct a kiln, a total number of 5 500-6 000 bricks are required, making allowance for breakage during construction. The kiln has two doors, diametrically opposite each other. The line of the doors must be perpendicular to the direction of the prevailing winds. The height of each door is 160-170 m, the width at the bottom is 1.10 m and at the top 0,70 m. One door is used for charging the kiln with firewood while the other is used for discharging the charcoal, the kiln doors are closed with bricks built up after the charge is completed and both are opened when the carbonization process is finished. This is a simple operation that is repeated each time the kiln is charged. It only involves placing brick over brick and covering with mud. Approximately 100 bricks per door are needed and they can be used until the bricks start to break from handling, the top of the kiln has a hole (called an "eye") of about 0.22 m-0.25 m diameter. Around the base at the level of the ground are ten holes evenly spaced (0.06 m height x 0.12 section). These holes are air inlets and the eye is the outlet for smoke. The foundation consists of a double row of bricks three courses high set in mud mortar.

Figure 3: Loaded half-orange kiln

- ✓ **Fuelwood:** Fuelwood to be utilized is cut to about 1.00 m - 1.30 m length with a minimum diameter 0.05 m and a maximum diameter equal to the width of the door. The kiln can be loaded with roughly 30 t of air dry wood, of moisture content 25%, and average specific gravity of about 850 kg/m^3.
- ✓ **Discharging:** Before discharging the charcoal, when the kiln is sufficiently cool, sufficient water must be available to avoid re-ignition when opening the door of the kiln. One drum of about 200 litres is sufficient for one kiln. The kiln is discharged by two or three men. The charcoal is conveniently

removed from the kiln with a special fork known as a stone fork. It has 12-14 teeth and a tooth spacing of 0.02 m. This allows the bulk of the fines (less than 20 mm) to fall through and remain in the kiln. The charcoal is placed on a 1.2 m square piece of canvas and carried by two men out of the kiln.

A total of 13-14 days should be adequate to complete a cycle to produce 9-10 tons of charcoal with a kiln of 7 m diameter. Using a kiln of 6 m diameter the approximate yield per burn is 7.5 t or 15t/month. Lower yields may be obtained when lower density or higher moisture content wood is used.

- Topic 5: Construction of improved metal kilns

The widespread use of cylindrical transportable metal kilns for charcoal production originated in Europe in the 1930's. During the Second World War the technique was further developed by the United Kingdom (U.K.) Forest Products Research Laboratory. Various versions of the original design have been used throughout the United Kingdom. This technology was transferred to developing countries in the late 1960's, notably by activities in the Uganda Forestry Department. Various versions are available in both developed and developing countries. Portable steel kiln, transportable metal kilns are all metal kilns.

- ✓ When the kiln is about half full we put the 'charge', or tinder into this central hole. This is very dry and highly combustible material, which ensures a good strong fire.
- ✓ Then the process of laying the logs down in a spiral fashion continues until they show about 4" above the top of the kiln and form a conical shape up to the centre. The lid is then hauled up into position, making certain that it sits centrally.
- ✓ With the lid jammed open to allow good air flow, the kiln is now ready to be lit. The ideal time to light a burn is on a windless and settled day, because any wind at all makes it much harder to control the way the fire burns.
- ✓ To light the burn, live coals are thrown into the central charge via the air inlets created by the first 'cartwheel' layer.
- ✓ Once we hear 'snap, crackle & pop', there is no going back!

Figure 4: Wood charging operation on left side and a well ignited metal kiln on right side

- Topic 6: Construction of improved casamance kilns

The casamance kiln was developed in casamance region of south Senegal in West Africa. It is basically a modification of the earth mound kiln. A distinctive addition on the casamance is the chimney which regulates air circulation and is crucial in improving the carbonization process.

The base is made up of two layers of small and medium sized wood. For the first layer, the wood is evenly laid out radially around the central point of the base and, for the second layer, the wood is tangentially arranged across the first layer. The base plays an important part for it assures air flow in the mound.

The layers composed of large billets (40 cm diameter) are arranged to within 50 cm of the extremity of the base starting from the centre.

The medium sized billets (20-40 cm) surround them and give strength to the mound. They cover almost the entire remainder of the base.

The last ring is composed essentially of short wood (20-40 cm in diameter) arranged on the outer extremity of the base. The diameter of the base varies according to the volume of the mound.

- ✓ For a mound of 30 m^3 a base of at least 3 m radius is needed
- ✓ For a mound of 90 m^3 a base of at least 4 m radius is needed.
- ✓ For a mound of 100 m^3 a base of at least 5 m radius is needed.

The mound is covered with grass and shrubs and then sand or loam. The chimney is placed at the edge of the pile as in the diagram, with its base opening connected to the base of the pile. The site of the mound should be cleared by rake and roots and stumps pulled out.

Once the fire is started constant supervision by the burners (3) is needed until carbonization has finished. The mound is lit in the central hole by throwing in live coals. When the fire has started (15 to 20 minutes) the central hole should be closed. Ventilation holes should be opened every 3 to 4 metres around the base of the mound. A hole should never be made near the chimney as this will only reduce the draught in the rest of the pile. If smoke does not rise out of the chimney, a small fire should be lit in it to make it draw.

As carbonization advances the mound sinks progressively and holes may appear which should be immediately blocked with grass and sand. The chimney should be removed if the side on which it is situated seems to be completely carbonised.

The different stages of carbonization are:

- ✓ Heating up: from the ambient temperature to 100°C
- ✓ Dehydration: between 100 and 120°C
- ✓ Exothermic stage which begins at 270°C, reaching 500 to 700°C when carbonization is complete.
- ✓ Cooling during which the chimney is removed and the mound is hermetically sealed.

After cooling the mound is opened with the aid of rakes beginning at the base. The opening should be closed after a part of the charcoal has been removed and this procedure should be continued until the operation is completed.

The fresh charcoal from the mound should be covered with sand to prevent ignition. This avoids loss in quality caused by extinguishing it with water. Only lump charcoal should be put in bags: brands and fines should be discarded. The bags should be closed with twine to which a cardboard label should be attached, for control purposes, indicating the weight and number of the mound.

The brands should be carbonised in the next kiln. Carbonization is at an end when the smoke starts to diminish and turns blue. From this moment it is the charcoal itself which is burning, hence the necessity to withdraw the chimney and close the mound hermetically. During the exothermic decomposition stage by-products are collected as condensate from the base of the chimney. The condensate is a mixture of wood tar and pyroligneous acid. The casamance mound is based on reversed draught, i.e. air flows in from the bottom of the vent holes and warm gas instead of escaping from the top, flows down and through the chimney which is connected to the base of the mound. During the cooling stage the charcoal burners should begin building the next mound, starting with the construction of the base.

Figure 5: Construction of casamance kiln

Figure 6: Monitoring of casamance kiln

- Topic 7: Comparative advantages and disadvantages of carbonization methods

The main advantages of transportable metal kilns compared with the traditional earth pit or clamp method are:

- ✓ Raw material and product are in a sealed container giving maximum control of air supply and gas flows during the carbonization process.
- ✓ Unskilled personnel can be trained quickly and easily to operate these units.
- ✓ Loss of supervision of the process is required compared to the constant attendance necessary with pits and clamps.
- ✓ Mean conversion efficiencies of 24% including fines (dry weight basis) can be consistently achieved. Pits and clamps give erratic, often lower yields.
- ✓ All of the charcoal produced in the process can be recovered. With traditional methods (pits and mounds) some of the charcoal produced is lost in the ground and that which is recovered is often contaminated with earth and stones.
- ✓ Transportable metal kilns, if designed to shed water from the cover, can be operated in areas of high rainfall, providing the site has adequate drainage. Traditional methods of charcoal production are difficult to operate in wet conditions.
- ✓ With maximum control of the process a wider variety of raw materials can be carbonised. These include softwood, scrubwood, coconut palm timber and coconut shells.
- ✓ The total production cycle using metal kilns takes two to three days.

- ✓ Initial capital to cover the cost of the manufacture of the kilns must be obtained. Basic mechanical workshop skills and equipment must be available and the steel used in the kiln construction often has to be imported.
- ✓ For ease of packing and maximum efficiency some care is needed in the preparation of the raw material. The wood must be cut and/or split to size and seasoned for a period of at least three weeks.
- ✓ Transportable metal kilns may prove difficult to move in very hilly terrain, although more gentle slopes can be easily traversed.
- ✓ The life span of metal kilns is only two to three years.

Topic 8: Advantages and disadvantages of using transportable metal kilns compared with fixed installations

- ✓ Transportable metal kilns can be easily and frequently dismantled and rolled along the forest floor to follow commercial timber extraction, plantation thinning or land clearance operations. This means that the laborious and expensive transportation of wood to a centralised processing site can be avoided.
- ✓ The total production cycle for these units is approximately one week, compared to the two to three days for the metal kilns.
- ✓ The cost of manufacturing a transportable metal kiln is usually greater than a brick-built kiln of comparable output. This is mainly because of the cost of raw material. Foreign exchange is needed in cases where the steel has to be imported. Sheet metal working skills and a workshop are needed for manufacture and maintenance.
- ✓ Because of the higher thermal insulation of the walls of the brick built kiln, less of the wood charged is burnt during the carbonization process and a slightly higher conversion efficiency is usually achieved than that obtained with transportable metal kilns. Brick kilns can carbonise large diameter wood and less cross cutting splitting is needed.
- ✓ The recovery of by-products from transportable metal charcoal kilos is not feasible. Where brick-built kilns are used, there are possibilities that the condensable tars may be recovered.
- ✓ Management supervision and logistical support is more readily supplied in a centralised processing situation where batteries of static brick-built kilns are in operation.
- ✓ Pits reabsorb pyroligneous acid through rain falling on the pit.
- ✓ The pyroligneous acids tend to condense in the foliage and earth used to cover the pit. on burning, the charcoal produces unpleasant smoke.

LO 2.2 – Prepare site for carbonization

- Topic 1: Selection criteria of site for kiln construction

A well-drained and roughly levelled area, approximately 3 metres in diameter, should be chosen in close proximity to the wood supply. Tree stumps and large root systems should be avoided and excessive undergrowth should be removed from the chosen area and the ground made firm by stamping it down. Loose earth or sand should be available close to the site for sealing off the air supply to the kiln during operation. A sandy or loamy soil is preferred and, if not available, a supply of sand should be obtained from a nearby stream for the initial operations. This material can be re-used and will soon increase in volume as charcoal dust and wood ash, produced during successive operations, are incorporated into it.

- Topic 2: Steps of site preparation according to the carbonization method

Carbonization site is prepared by clearing the site and leveling it according to the method to be put in place. The earth mound is preferred over the pit where the soil is rocky, hard or shallow, or the water table is close to the surface. By contrast the pit is ideal where the soil is well drained, deep and loamy. The mound is also more practical in agricultural zones where fuelwood sources may be scattered and it is desirable to make the charcoal near a village or other permanent site. A mound site can be used over and over again, whereas pits tend to be used a few times and then new ones dug to follow the timber resource. Also where the water table is close to the surface or drainage is poor, pits are not practical. The repeated digging of pits also disrupts cultivation for crops or pasture.

LO 2.3 – Load kiln for carbonization

- Topic 1: Earth Kiln loading system

The bigger diameter logs must be placed in the centre where prolonged higher temperatures are reached. The fuelwood in the kiln is stacked in a vertical position to a height of 1.20 m (length of wood). Placed over the vertical logs are logs in a horizontal position, bringing the kiln up to complete capacity. Special care must be taken that the holes at the base of the kiln (air inlets) are not closed. Some small dry wood is placed on top of the charge under the eye to assist in lighting the kiln. When loading is completed both main doors must be sealed using bricks covered with mud.

Figure 7: Earth kiln loading system

- Topic 2: Metal kiln Loading system

Woods are chopped into pieces depending on size of the container.

Then it gets stacked up and left to season for just over a year.

The first layer of woods to go in the kiln is placed in an open cartwheel or star shape (not shown here). This allows air to enter the kiln at the base, ensuring good air flow for the first stage of the burn.

Then for each subsequent layer, the logs are placed around the circumference of the kiln, and then spiraling inwards until a fairly small hole in the middle of the stack remains.

Figure 8: Metal kiln loading system

- Topic 3: Criteria for selecting lighting zone and Kiln ignition

After kiln building is completed, it is lit through ignition eye left while piling. Charcoal producers generally begin lighting early in the morning under the windless air conditions. When the wood is alight, the ignition eye is then closed and some small openings or air inlets are opened around the base of the pile to allow the control and monitoring of the process. The intensity of fire is also regulated by these air inlets, which are not fixed, new ones can be opened or closed according to expansion of burning zone. It takes 8-10 hours to initially heat and ignite the kiln.

LO 2.4 – Monitor kiln combustion and cooling

- Topic 1: Monitoring metal kiln combustion and cooling

The burn is now under way and for the next 2 to 3 hours the focus of work is on getting the fire to spread across the centre underside of the kiln; this is why weather conditions are so important, because if the kiln does not burn evenly, the charcoal will not form correctly and then the timber is wasted.

As the smoke pours out the fire grows steadily stronger, until the embers start to drop around the outer edge.

In this picture we can see the base of the kiln, which is slightly raised off the ground, giving us a view of the glowing interior, and this is where we can see the embers beginning to drop down.

The fire comes round, and smoke continues to appear in a huge plume. At this stage when we know we have a good strong evenly-burning kiln, it is time to begin to reduce the amount of oxygen getting into the kiln, this will slow down the burning process and if we get it right, should make us some charcoal! So, to do this sand is shoveled around the bottom of the kiln to close up the gap at the base.

Figure 9: Maintenance of metal kiln

Next we need to seal up the lid properly with sand. As you can see from this picture this is a very hot and dangerous job! Large flames are still dancing out from the shoes at the base of the kiln, so great care must be taken. Heavy metal chimneys are now placed into 4 of the shoes to create exhaust flues. The other 4 shoes become air inlets.

Figure 10: Carbonization process of metal kiln

For the next 14 to 20 hours we monitor progress, as it's important to ensure the kiln stays sealed. The smoke from the chimneys gradually grows thinner; we are looking for a change in the colour of the smoke from gray to blue, when this happens we know the burn is complete.

Eventually the chimneys will be removed and all 8 shoes are blocked off with sand, thus sealing the kiln completely. The kiln is left for at least 24 hours to cool down, and during this time we must still keep checking that the sand keeps it sealed. Once cooled and safe enough to work with again, the lid can be lifted.

- Topic 2: Procedures of cooling kiln

All holes at the base and the eye of the kiln must be open. Some pieces of burning charcoal, dry leaves and small branches are thrown through the eye to ensure that the firewood is well alight. After some minutes a visible dense white stream of smoke starts to come out through the eye. This phase represents first distillation and the wood loses its water content at this stage. The white smoke continues for some days (depending on the water content) and then starts to become blue, showing effective carbonization is in process. This process is controlled by opening and closing the air inlets at the base of the kiln. No flame must appear through the eye. When the carbonization process is completed the smoke becomes almost as transparent as hot air. At this point the holes at the base must be closed with mud or covered with earth and sand. This phase is called "purging". After this phase the top eye hole is closed, starting the cooling phase. The cooling is accelerated by throwing mud (diluted with water) on the kiln. Apart from cooling, this helps to cover any hold or crack in the walls, thereby preventing any entry of air. The slurry of mud and water must be applied about three times per day.

Learning Unit 3 – Harvest charcoal and by-product

LO 3.1 – Cool charcoal

- Topic 1: Procedures of charcoal cooling

Charcoal cooling is done by closing all air inlets hence allowing charcoal kiln to cool. Cooling varies from the method adopted. For brick kiln and metal kilns water is sprayed onto the walls. Charcoal burned in earth mound and pit are cooled by mixing them with humid soil.

LO 3.2 – Pack charcoal

- Topic 2: Criteria of packing charcoal and by-product

✓ Quality: To speed up this operation a sieve chute should be used to separate the large charcoal pieces from the fines and dust. It is recommended that the bottom section of the kiln be positioned on the leeward side of the charcoal and used to support the sieve chute. This will not only increase the stability of the sieve but will reduce the amount of dust reaching the operator.

✓ Market

✓ Transport means

✓ Storage conditions

- Topic 3: Steps of packaging

✓ Filling

✓ Weighing

✓ Sealing

✓ Labelling

LO 3.3 – Transport charcoal

- Topic 1: Conditions of transport of charcoal and by-products

Experience shows that transport problems are less when there is only a single loading and unloading stage. This is achieved easily when trucks are used. Costs per ton/km are usually lowest when large unit loads are transported. Twenty ton loads using a truck and trailer both equipped with high sides are practical. In this case the charcoal is handled in bulk. Most fines are produced in loading/unloading operations. To reduce this problem transport of charcoal in a single operation from charcoal kiln to main distribution/storage point is recommended.

Bulk handling and transport is often not regarded by traditional producers as practical, so that bagging of charcoal is necessary. But where large quantities of charcoal are regularly transported between a production centre and the distribution point, bulk transport without bags should be developed in order to keep down packaging, transport and handling costs.

Charcoal easily absorbs water and, therefore, tarpaulins or other covers must be used during transport, to prevent wetting. There is always a risk that charcoal will be wet by rain during the few days it is "curing" at the side of the kiln. Cured charcoal should be transported as soon as practical to reduce this risk. Plastic sheet covers or a galvanized iron open sided storage shed can be used where large amounts must be accumulated prior to transport. Every effort should be made to avoid double handling at the kiln, leading to wasteful production of fines and unnecessary labour costs.

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