Notes for guidance

Template quality management scheme for the production of a hydraulically bound mixture

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This quality management scheme provides a method statement for the quality control and production of a hydraulically bound mixture using a factory production control system compliant with harmonised British and European standards. It specifically applies to the mix-in-plant production of an HBM and no other production method.
WRAP helps individuals, businesses and local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change.
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1.0 **Organisation**

- Outline the organisation structure and define the inter-relation of personnel who manage, perform and verify work affecting quality.
- Appoint a management representative and identify operational staff that will follow the procedure and be responsible for the day to day implementation of the Quality Management Scheme (QMS).

**Personnel may be identified in an organisation chart (Figure 1).**

![Figure 1: Organisation structure relating to quality](image)

1.1 **Management and staff responsibilities**

The appointed management representative will have the appropriate authority, knowledge and experience of production control to ensure that the requirements of the quality management scheme are implemented and maintained.

- Identify personnel who have the authority to identify, record and rectify any mixture quality problems.
- Clearly identify responsibilities and tasks for every stage of the process.

1.2 **Resource management**

1.2.1 **People**

- Define roles within the organisation and/or site, with a description of their responsibilities and a clear reporting structure.
- Detail the procedures for recruiting and training staff, including identification of staff responsible for identifying the need for and managing the recruitment and training. Records should be kept of training that has been provided.
- Identify methods of communication and staff involvement in the quality management system.

**Personnel should be suitably qualified either through appropriate education, training or experience for the assigned task.**

Recruitment, appraisal and development of all employees are processes needed to enable the organisation to meet the overall company objectives.

1.2.2 **Suppliers**

- Describe the procedure adopted for acquiring suppliers or checking the suppliers and/or checking their ability to provide you with services or the input materials most suitable for your site/process.

Such a procedure is likely to be dependent on the particular situation of your organisation and/or site, but must include controls on Statutory and Regulatory requirements and could include the following, where applicable:

- the supplier should be informed of your material requirements, that is specifications and tolerances of the materials you wish to receive at your operation(s);
- the presumed ability to supply the right materials should be checked through appropriate procedures and controls; and
- acceptance or rejection of their services should be communicated to them.
If the input materials for the process are waste, Statutory and Regulatory requirements apply;
- your material supplier must be able to demonstrate that he/she either:
  - holds a Waste Management Licence; or
  - is a registered Waste Broker; or
  - is registered for an exemption from licensing.
- the carrier of such material must be a registered Waste Carrier.

If the input materials for the process have been recovered from waste, the supplier must demonstrate compliance with the WRAP Quality Protocol for the production of aggregates from inert waste (incorporate Section 6 into the QMS).

The Protocol, checklists and guidance for producers and specifiers are available on line via www.aggregain.org.uk/quality/quality_protocols/.

If applicable a visit to the suppliers’ operations (e.g. demolition site, quarry, waste production site, or recycling centre) could be organised to learn about their working practice and/or the likely quality of the materials to be received.

1.2.3 Plant, equipment and stores
- Facilities need to be well maintained and in good working order to ensure that the staff can operate safely and efficiently to the quality requirements.
- All plant and equipment should be sourced from accredited suppliers, and records shall be maintained of identification and details.
- The Factory Production Control requires that the organisation should provide for the control, calibration and maintenance of inspection, measuring and test equipment.
- Plant and equipment, including testing tools, shall also be serviced regularly and calibrated where applicable.
- Storage areas for goods such as input materials, equipment and products, shall be identified to ensure that such goods are stored to prevent damage and deterioration and can be maintained in accordance with the supplier's recommendations and regulatory requirements.

It is good practice to produce, where possible, a plan of the operational site, reporting, within others, the position of the storage areas.

1.3 Audit and Records

1.3.1 Internal audit
Internal audits are required to assess the effectiveness of the quality management scheme and verify compliance.
- Set out a schedule for internal audits based on the status and importance of the activity. The results of the audit should be recorded and deficiencies reported to personnel responsible for that activity. Corrective action should be undertaken and recorded by the management personnel responsible for that activity.

1.3.2 Management review
In general the management of the organisation has the responsibility for introducing and maintaining the Quality Management Scheme including defining and ensuring the communication of a suitable quality policy and related quality objectives. The managers are also responsible for conducting periodical reviews of the whole system to ensure its continuing suitability and effectiveness.

The management is responsible for ensuring that:
- responsibilities and authorities are defined and clearly communicated within the organisation; and that
- measurable quality objectives and product requirements are established at relevant levels and functions within the organisation.
1.3.3 Records

Set out the procedure for record keeping and state the period of time that they shall be retained. Records for retention include:

- procedures & instructions;
- internal audits non compliance and corrective actions;
- management reviews;
- training records;
- receipt, acceptance or rejection of materials;
- control of outside services (suppliers);
- inspection and calibration records;
- results of tests and inspections;
- non conformity of feedstock and action;
- non conformity of product and action; and
- production and storage data.

Records are generally kept for at least three years or longer if legally required.

2.0 Control Procedures

2.1 Production management

State:

- the composition of the mixture. The composition of the mixture should be established from a laboratory mixture design procedure, intended to ensure the mixture has the required properties. A mixture base line or target composition can be demonstrated by a catalogue of mixture compositions if the mixture is regularly produced.
- the equipment and installation required for production; and
- instructions so that the mixture is identifiable up to the point of delivery as regards source and type.

Detail procedures:

- to adjust mixture composition. Make allowance for a periodic review to ensure the mixture conforms to requirements and to take account of any change in properties, in the case of a significant change in constituents the composition should be re-established;
- to ensure that constituents comply with requirements;
- to ensure that production equipment, including storage facilities, maintain the composition, homogeneity and consistency of the mixture;
- for calibrating, maintaining and adjusting the process and testing equipment;
- for sampling the constituents and the mixture;
- for data recording during processing; and
- for adjusting the process according to weather conditions.

2.1.1 Constituents

Detail the source and type of each constituent of the mixture.

If the mixture comprises material recovered from a waste stream, demonstration of the recovery process must be documented.

If the production process includes processing to recover aggregate from inert waste, Statutory and Regulatory requirements apply (include Section 6.0 within the QMS).

Adequate supplies of constituent should be available to ensure that the planned rates of production and delivery can be maintained. The specifications for incoming constituents should be established and communicated to suppliers by means of written orders (see Section 1.2.2).
Constituents should be transported and stored in such a manner as to avoid intermingling, contamination or deterioration that may affect the quality of the product.

2.2 Inspection, calibration and control of process equipment

- Identify the equipment that requires calibration, the frequency of calibration, the required accuracy and the personnel responsible for the calibration and record keeping.
- Identify personnel responsible for equipment inspection and record keeping, and state frequency of inspections.

The process equipment should be adequately maintained to ensure that it continues to be capable of producing mixture to the required specifications and tolerances. Detail the servicing and maintenance periods.

2.3 Handling and storage

- Set out procedures to ensure that the mixture is handled and (where appropriate) delivered with the minimum of segregation or degradation and within the permitted water content range and time limit.

At the point of delivery the mixture should be identifiable and traceable with regard to its production data. The producer should maintain records of relevant data of production which can be referenced from information when appropriate on the delivery ticket.

If appropriate describe the characteristics of any mixture storage system and define its mode of operation. The producer should ensure through checks inspections and records that such systems are used correctly and that mixtures maintain their suitability for use.

2.4 Production process control

- Describe the process and provide a flow diagram of the process.
- Provide a schedule for monitoring the performance of the process, including a record of equipment performance against stated tolerances.

Figure 2 is an example for HBM production utilising quality products, such as aggregate recovered from inert waste (in accordance with the WRAP Quality Protocol available on line via www.aggregain.org.uk/quality/quality_protocols/) and primary aggregates.

Figure 3 is an example for HBM production utilising inert waste such as trench arisings or demolition waste that has not yet been recovered from the waste stream utilising the WRAP Quality Protocol.

These figures make reference to the Highways Agency’s manual of contract documents for highway works (MCHW) which is available from www.standardsforhighways.co.uk/mchw/index.
Figure 2: Example flow diagram for HBM production process utilising quality products

1. Constituents delivered to HBM production facility.
   - Pass
   - Fail
     - Reject material and notify.

2. Check recycled materials have been recovered in accordance with the WRAP Quality Protocol (using the purchaser’s checklist).
   - Pass
   - Fail
     - Reject material and notify.

3. Accept constituents HBM production facility.

4. Store constituents separately in demarked areas.

5. Categorise constituents for use as feedstock.
   - Pass
   - Fail
     - Reject material and notify.

6. Proportion constituents as stated in the HBM design, in accordance with MCHW Clause 814 or 815. Mix and add water to achieve designed HBM.
   - Material may be suitable for reprocessing
   - Reject material and notify.

7. Compliance testing to monitor product.
   - Pass
   - Fail
     - Reject material and notify.

8. Store product in demarked area. Clearly label date of manufacture and use by date. Protect from weather to prevent deterioration.

9. Dispatch with recommendations for use.
Figure 3: Example flow diagram for HBM production process utilising inert waste

- Waste delivered to recycling facility.
  - Obtain information on source of waste to assess variability
  - Fail
  - Pass

- Apply waste acceptance criteria.
  - Reject material and notify.
  - Pass
  - Accept

- Weigh and categorise.

- Allocate to appropriate stock area.
  - Reject material and notify.
  - Fail

- Re-inspect for compliance with waste acceptance criteria.
  - Reject material and notify.
  - Fail
  - Pass

- Segregate and allocate to appropriate stock area.
  - Remove wood and plastic

- Screen and/or crush oversize material and/or blend.

- Allocate to product stockpiles.

- Confirm recycled materials have been recovered in accordance with the WRAP Quality Protocol (using the producer's checklist).
  - Reject material and notify.
  - Fail
  - Pass

- Select recycled materials for use in HBM.

- Source additional constituents required for HBM.

- Store constituents separately in allocated stockpiles.
  - Reject material and notify.
  - Fail

- Categorise constituents for use as feedstock.
  - Reject material and notify.
  - Fail
  - Pass

- Proportion constituents as stated in the HBM design, in accordance with MCHW Clause 814 or 815. Mix and add water to achieve designed HBM.
  - Material may be suitable for reprocessing
  - Reject material and notify.
  - Fail

- Compliance testing to monitor product.
  - Allocate to covered product stockpile.
  - Clearly label date of manufacture and use by date.
  - Protect from weather to prevent deterioration.
  - Pass

- Dispatch with recommendations for use.
3.0 Inspection and testing of constituents and mixture during production

- State the characteristics that require control during production and refer to the requirement of the target composition of the mixture to ensure the constituents are capable of providing the required quality.
- State the frequency of product sampling according to the plant and output or time related.
- Specify the frequency and nature of regular tests/checks/inspections that should be carried out during production.
- Sampling from stockpiles to be in accordance with BS EN 932-1.

An example of a production control schedule is given in Table 1. Characteristics may include:

- water content of constituents;
- proportioning of constituents including water;
- adjustment to accommodate constituent and weather changes;
- grading of mixture; and
- water content of mixture.

The schedule of frequencies should consider:
- test frequencies in relation to periods of actual production of each mixture;
- test frequencies where automated surveillance and monitoring of the process exists; and
- statistical approaches for testing.

### Table 1: Example control testing schedule

<table>
<thead>
<tr>
<th>Property description</th>
<th>Test method</th>
<th>Minimum test frequency</th>
<th>Design requirement</th>
</tr>
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<tbody>
<tr>
<td>General description</td>
<td>Visual inspection</td>
<td>Every incoming load</td>
<td>-</td>
</tr>
<tr>
<td>Aggregate composition including organic material</td>
<td>MCHW Clause 710</td>
<td>1 per month*</td>
<td>Maximum foreign material</td>
</tr>
<tr>
<td>Water content (aggregate)</td>
<td>BS 1924-2</td>
<td>Daily*</td>
<td>State tolerance</td>
</tr>
<tr>
<td>Particle size distribution (aggregate)</td>
<td>BS EN 933-1</td>
<td>1 per week*</td>
<td>Maximum and minimum grading envelope</td>
</tr>
<tr>
<td>Water content or moisture condition value (MCV) at mixing and final compaction</td>
<td>BS 1924-2 or BS EN 13286-46</td>
<td>Daily*</td>
<td>State tolerance around optimum water content or MCV range</td>
</tr>
<tr>
<td>Particle size distribution (Product)</td>
<td>BS EN 933-1</td>
<td>1 per week*</td>
<td>Declare grading</td>
</tr>
<tr>
<td>California bearing ratio (CBR) for stabilised materials for fill (SMF) given in the Specification for the reinstatement of openings in highways (SROH)</td>
<td>BS EN 13286-47</td>
<td>1 per week*</td>
<td>Specify target CBR range (90 day value)</td>
</tr>
<tr>
<td>Compressive strength for HBM and structural materials for reinstatement (SMR) given in the SROH</td>
<td>BS EN 13286-41</td>
<td>1 per week*</td>
<td>Specify target strength range and age</td>
</tr>
<tr>
<td>Frost heave</td>
<td>BS 812-124</td>
<td>1 per year</td>
<td>No requirement or non frost susceptible</td>
</tr>
<tr>
<td>Workability period</td>
<td>BS 1924-2 or BS EN 13286-46</td>
<td>1 per year</td>
<td>State time to set in hours/days</td>
</tr>
</tbody>
</table>

* Time periods relate to production periods not calendar periods

During the regular production of the mixture, the sample frequency may be as follows:

- In the case of plants with a validated and accepted automated surveillance and data collection system giving computerised composition for every truck or every batch, one sample should be taken every 2 000 t or 1 000 m³ or one per day for lesser quantities.
- In the case of other types of plants or production, one sample should be taken every 300 t or 150 m³, with a minimum of 1 sample per day.
Alternatively and independent of the type of mixing plant, the frequency of sampling can be on a time related rather than a quantity related basis such as a minimum of 1 sample per week or 1 sample per day depending on the characteristic being measured.

In the case of occasional production of a standard mixture, the production should be assessed cumulatively with previous production with the same or similar criteria. The frequency of sampling can be adjusted on a contract-by-contract basis according to the overall quantity of production required.

Reasons for changing the test frequencies and analysis should also be stated. For example long term experience of the consistency of a particular property may be taken into account.

4.0 Inspection and testing equipment

Outline the necessary facilities, equipment and personnel required to carry out the inspections and tests and ensure they are available.

Detail the specified test methods given in the relevant standard. Other test methods may be used, if correlations or safe relationships between the results of these test methods and the reference methods have been established.

4.1 Measuring and testing equipment

Describe how the equipment is maintained and calibrated.

Set out a procedure for the control, calibration and maintenance of the inspection, measuring and testing equipment.

4.2 Measuring and testing equipment in the process

State the points in the process where measuring equipment needs to be deployed and indicate when control is carried out automatically or manually.

4.3 Measuring and testing equipment in laboratory

To ensure that the testing equipment is in a known state of calibration and accuracy, consistent with the required measurement capability, the following points should be addressed:

- accuracy and frequency of calibration, which should be in accordance with the relevant test standard;
- equipment to be used in accordance with documented procedures;
- equipment to be uniquely identified and calibration records should be retained; and
- keeping of calibration records.

5.0 Non conformity

In the event that a non conforming constituent, process or mixture is identified, investigations should be initiated to determine the reasons for non conformity and effective corrective action should be implemented to prevent recurrence.

Non conformity can arise at the following stages:

- constituent delivery;
- constituent in storage;
- mixture production; and
- handling, storage and delivery of the mixture if appropriate.

5.1 Constituent non conformity

Identify the action to be taken when a non conforming constituent is identified and state the circumstances under which the supplier will be notified of non conforming results.

Corrective action may involve:

- reclassifying the constituent;
- reprocessing;
- adjusting process control to allow for constituent non conformity; and
- rejection and disposal of the non conforming constituent.
5.2 Product non conformity

- Identify the action to be taken when a non conforming product is identified and state the circumstances under which the customer will be notified of non conforming results.

Such action may involve:
- corrective action (for example modification of the mixture and or adjustment of equipment);
- acceptance of the mixture following the agreement of the customer to accept a non conforming mixture;
- if the mixture produced is incorrect it can be redirected to an alternative customer if appropriate; and
- rejection of the mixture.

6.0 Recovery from inert waste

The management controls outlined in Sections 1 to 5 apply to the production of aggregate from inert waste with the additional controls (outlined in this Section) to satisfy Statutory and Regulatory requirements. Further guidance on the recovery of aggregate from inert waste can be accessed on line via www.aggregain.org.uk/quality/quality_management_tool/inert_wastes/index.html.

6.1 Incoming waste materials

To satisfy requirements of regulations on waste, Duty of Care and the aggregates standard, information regarding the incoming waste must be obtained.

- State the information to be obtained and frequency:
  - Regulatory information – with each load
  - Production control information – either by load or batch depending on the supply

- The information obtained should be opportunely recorded and the records maintained for the Statutory period.

- Check that the material matches the requirements, that is, it can be processed and the level of contamination in it is acceptable.

The recycler is required by law to obtain and maintain certain records on the waste received, for inspection by the relevant authorities. In addition, the Factory Production Control requires that documentation detailing the nature of the raw material and its source is obtained (see Section 2.1.1). As it is the recycler’s responsibility to ensure that concentrations of any and all dangerous substances in the recovered material are within the limits in force, it is important to obtain as much information as possible on the input materials with regards to such substances.

- Indicate as a minimum the following information to be obtained:
  - waste management licence or registration of exemption;
  - waste carrier/waste broker registration details;
  - material’s details (type of waste);
  - location of arisings (demolition site / plant);
  - demolition or building contractor details/ supplier details; and
  - date of demolition/arising/production.

Regulatory information is available from the Waste Transfer Notes that must accompany each and every load of waste delivered to site. Production control information is available from the supplier.

Be aware that not all contamination is visible; for example, concrete waste arising from the demolition of an industrial site may not be suitable if contaminated because of the nature of the industrial operations.
6.2 Receipt of waste materials

Specify the criteria and the methods to be applied for ensuring compliance with Statutory duties and processing requirements.

Specify procedures for the receipt of materials, stating who is responsible for receiving and accepting the load and accompanying documents.

Duty of Care requires that the waste received has a traceable owner and origin and it is transported by authorised people.

The Factory Production Control requires that the material and any dangerous substances contained are controlled.

6.2.1 Records on the received material

As a Statutory requirement, the Waste Transfer Notes accompanying the waste received must be kept for at least two years.

Also record:

- the deliveries accepted: date; nature and quality; place of origin (where known); carrier; supplier; and
- the loads rejected (with details on the reason for the decision).

6.2.2 Arrival

Define the actions to be undertaken when a load of waste arrives to site. Specify what needs to be done when the material is acceptable and when it is not.

State who is responsible for accepting or rejecting the load.

Actions include inspecting the load against the specified acceptance criteria which includes as a minimum:

- Existence of a Waste Transfer Note recording all the details on the ownership and origin of the load of waste (Statutory requirements); and
- Site/process specific material requirements, including acceptable contaminations and limits.

6.2.3 Rejections

Loads not accompanied by a Waste Transfer Note should be rejected as not compliant with the legislation.

The site operator may reserve the right to reject any waste they consider to be unsuitable for recycling and/or incorrectly coded.

Specify how to deal with waste materials which do not satisfy the site/process specific material requirements and procedure to notify supplier.

6.3 Accepted loads

6.3.1 Weighing and categorising

Specify the steps to be taken when waste is accepted before it is allocated to a stockpile or fed into the processing plant to ensure the material is handled in a controlled manner. The material is still a waste at this point, therefore, waste management regulations apply.

The waste should be weighed and categorised using the internal feedstock categories. Record the weight and the category that has been assigned to the waste accepted and provide for other means to ensure identification and traceability of the input material.

Define who is responsible for:

- weighing and categorising the load; and
- sending it for tipping.

Define which information/documentation must be recorded, where it will be held and by whom.

- weight and feedstock category of the load; and
- any (internal) documentation reporting the identification of the load (if applicable).
6.3.2 Re-inspecting and stockpiling

- Specify the steps that need to be taken when waste is about to be stockpiled ready to be fed into the processing plant.
- Detail how to ensure that different feedstock materials are stored separately (to avoid cross contamination) and in the assigned area.
- Identify the storage areas on site so that all staff know where to find the materials needed for a given process.
- State who is responsible for the following actions:
  - inspecting the load during tipping (if applicable);
  - confirming categorisation;
  - accepting or rejecting the load;
  - recording details of the load;
  - cleaning the load (if applicable); and
  - stockpiling.
- Define which information/documentation must be recorded, where it will be held and by whom:
  - acceptance or rejection; and
  - any internal documentation reporting the identification of the load (if applicable).
- Provide for a further inspection of the load during tipping to confirm acceptance, as contaminations may be hidden in the bulk of the load. Staff are to check the load during tipping to confirm the earlier categorisation and against the acceptance criteria:
  - if the load is acceptable, it can be allocated to the relevant stockpile of feedstock; and
  - if the load does not conform to the acceptance criteria, the waste could be re loaded on the truck straight away and sent back to the owner, or quarantined until collection for disposal.

6.3.3 Confirmation of acceptance or rejection

- Provide clear instructions on how to record the acceptance or rejection of the load, and consequent actions required for improving relations with the suppliers, for example discussing with the supplier the reasons for the decision to reject a load and the actions needed to avoid rejections on future loads.

It is good practice to provide for cleaning feedstock material at the earliest convenient occasion. Before the material is stockpiled staff may perform an initial sorting for example handpicking foreign materials such as wood plastic and metals. Allocate containers or bay space for such contaminants for facilitating their recycling or disposal.

6.4 Processing

- Define input materials, processes and products (include headings from Section 2 and apply procedure to waste recovery process)
- Set out the frequency and nature of testing/inspection on the input materials, equipment and products, including provisions for:
  - stocked material being checked to ensure that it has not deteriorated during storage;
  - equipment being calibrated and properly used; and
  - non conforming products being properly managed and recorded.
- Set out a procedure to ensure that the right material is fed to the right process and at the right rate. The identification information must be passed on to the next stage.
- Set out the control procedures to ensure that:
  - the right equipment is used for the process;
  - the equipment is calibrated;
  - the equipment is performing as expected and corrective action if it is not; and
  - controls are recorded.
Define who is responsible for:
- controlling that the method statement of production is followed;
- controlling the input materials, the feed and the equipment;
- managing non conformities; and
- recording the results of controls.

6.5 Recovered material

Set out the testing/inspection procedure and frequency of testing to be conducted on the finished product (recycled material) to ensure:
- non-conforming products are properly identified and recorded;
- the product is identifiable up to the point of sale as regards source and type; and
- the results of the Factory Production Control are recorded.

Define cases in which testing frequencies may be varied.

Set out the procedure for daily recording of the results of the process control.

Set out the procedures for dealing with non-conforming products, and to record actions this may include:
- product reprocessing;
- diversion to another application for which the non-conforming product is suitable; and
- rejection (with appropriate labelling).

Details on the non-conforming products and remedial actions shall be recorded for further investigation and, if necessary, corrective action.

6.5.1 Product stockpiling

Describe how the product will be stockpiled in a controlled manner to avoid cross contamination and deterioration.

Define who is responsible for:
- controlling the products and categorising them according to relevant Standards and specifications; and
- managing non conformities.

Define which information/documentation must be recorded, where it will be held and by whom.
- daily process control record; and
- records of non conformities.

7.0 Quality statement

Delivery documentation shall state that the product was produced under a quality management scheme, conforming to the WRAP Quality Protocol (where applicable).

It is good practice for the producer to provide recommendations on the installation of their HBM in different applications to enable contractors to achieve optimum performance from the product.

Recommendations may include:
- setting times;
- strength development;
- shelf life and storage methods;
- affect of storage on properties such as strength and long term performance;
- methods of laying, compaction and protection;
- weather implications during installation, and in the short term;
- design advice for particular applications;
- site control methods and tests; and
- immediate traffickability.