Phytobac Manual Part Two

Phytobac Construction & Operation

Phytobac®
Bayer CropScience

Contents

Legal Disclaimer

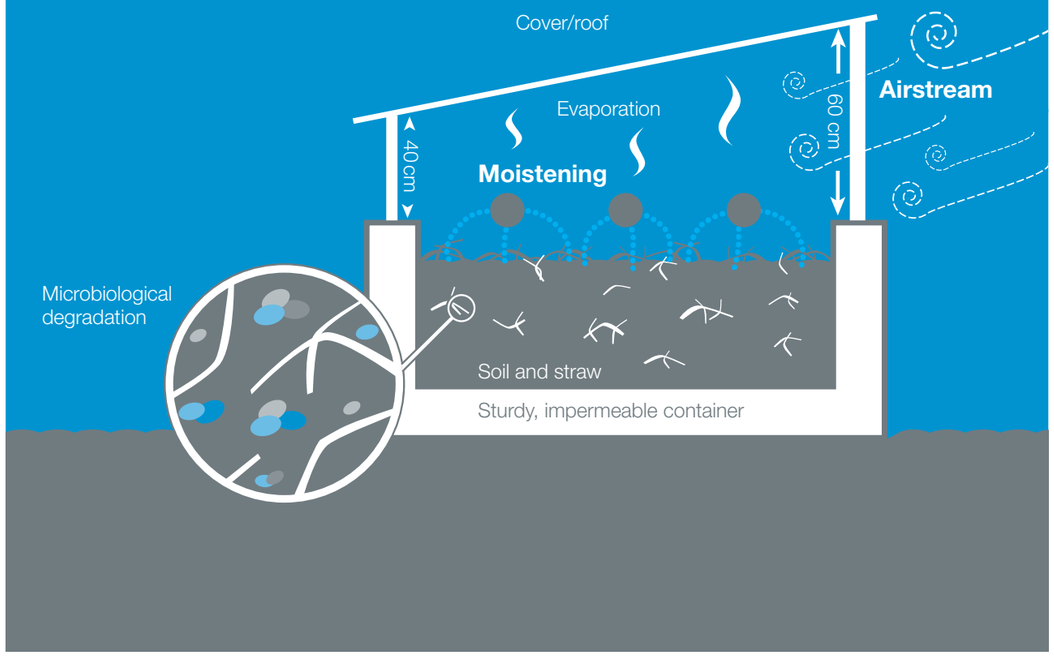
Phytobac® is a natural waste recovery and degradation system for non-hazardous pesticide washings designed to work by evaporation. The use of the Phytobac Manuals and results provided by the Bayer Phytobac Calculator is under the user's sole responsibility. The user is solely responsible for making the decision to install the system, sourcing materials for the system, and for its installation. Bayer CropScience Ltd expressly disclaims any liability, and gives no guarantees or warranties and makes no representations express or implied in relation to Phytobac®, except that liability for death or personal injury resulting from the negligence or breach of any contract by Bayer CropScience is not excluded by this provision.

Principle of Operation

The Phytobac combines the proven ability of biobeds and biofilters to degrade the active ingredients in pesticides with the benefit of enhanced evaporation. In combining these two principles it is possible to create a unit from which no discharge is made. To achieve this, the Phytobac must be built to match its capacity to the volume of liquid which enters it. The liquid is distributed uniformly over the surface of the biomix by irrigation (often drip types) to ensure the action of the Phytobac is maximised.

HOW THE PHYTOBAC WORKS

The Phytobac system enables contaminants typically originating from the filling, cleaning and washing of spray equipment, to be retained and degraded by microbial means, i.e. bioremediation. Phytobac is a sealed container of waterproof concrete, metal or plastic walls. The container is filled with a biomix of 70% topsoil and 30% chopped straw. The topsoil should be from conventionally cropped fields as this encourages the growth of the necessary microbial strains. The straw gives the biomix the required degree of porosity and serves as an energy source for the microorganisms.



Construction Detail

The required sprayer fill area is identical to that for a biobed or biofilter. As with all closed systems it should be roofed to prevent rain water entering the system.

The Phytobac requires an impermeable container to retain the biomix; a general concrete tank which allows 600mm depth of biomix is sufficient. It is noted from development trials that depths greater than 800mm of biomix within the Phytobac have led to anaerobic conditions which reduces the efficiency of the system.

Concrete side and rollable roof

Development of the tank must adhere to British Standard BS5502 part 22. This standard, ensures a high quality of construction to minimise pollution risks, and lists relevant details to ensure the tank is impermeable.

These construction standards are similar to those needed in silage stores to control effluent escape through joints within the concrete, where water stop systems are included. The trough may typically be 3m wide and 15m long which highlights the need for careful attention to concrete laying.

European experience has shown that Phytobacs can be constructed from concrete block walling, provided that it is rendered, giving full attention to all joints involved. Phytobacs may be produced from a wide range of impervious containers; see end of document for further illustrations.

Phytobac with roof lifted for inspection, filling or turning

An important difference between a biobed and a Phytobac is the ‘roof’ to the Phytobac. This can be a curved polycarbonate translucent cover, a flat and sloped polycarbonate cover, or a curved plastic film type, as with a polytunnel.
This will allow sunlight to pass to the surface of the Phytobac but not rainfall. Thus the Phytobac surface will be warmed and there will be some pesticide breakdown via UV light.
In addition, the roof is mounted to allow an air gap of approximately 300mm at the side which allows air movement across the biomix surface and so promotes evaporation. An angled roof, see Phytobac illustration, increases air movement across the biomix surface, thereby increasing the rate of evaporation.

There is a need to load and turn the biomix as well as attending to the irrigation system, therefore the roof or cover should be simple to remove.

Pre Phytobac Liquid Storage

As with a biobed or biofilter it is beneficial to include a liquid buffer tank between the bunded sprayer fill area and the Phytobac. This should be sited and constructed to ensure the safe containment of liquid prior to entering the Phytobac. To comply with government regulations (RP27 – Sprayer or applicator load and washdown area) a buffer tank can have a maximum capacity of 1,500 litres. Combined with a bunded fill area a significant holding capacity can be formed which can accommodate the emergency containment that matches the capacity of the sprayer tank.

The spray pad can be constructed so liquid can transfer from the fill area, passing through a silt trap, via gravity. The silt trap is essential to retain fine soil particles and prevent the blockage of the drip irrigation system that distributes the liquid over the surface of the Phytobac. Contents of the silt trap can be spread on to the surface of the Phytobac biomix as required (ensuring appropriate Personal Protective Equipment is used).

Inspection hole

Where the pre Phytobac buffer tank is included, a suitable pump will be required to transfer the liquid to the drip irrigation. This pump is controlled via a float switch or level switch system within the tank. The aim is to maintain some liquid in the tank to offer dilution to products entering the system and to control loading to the Phytobac. Controlling irrigation is an integral part of Phytobac management. For the biomix to work efficiently a steady level of moisture should be maintained, however excessive irrigation can create anaerobic conditions and reduce its ability to breakdown contaminants.

ThetaProbe image courtesy of Delta-T Devices

It is important to ensure the Phytobac does not become waterlogged. This can be achieved through a variety of systems either within the pre Phytobac tank or the Phytobac itself. The latter is likely to be a screened off float switch or moisture meter system within the Phytobac which overrides the supply pump and thus manages the moisture within the system.

The pump(s) used can be simple submersible, centrifugal pumps. Mains voltage should be supplied through suitable circuit breaker systems. The pump may only need to be around 200 W dependent on type and irrigation system chosen above the Phytobac.

Sizing a Phytobac

The Environment Agency has now included the Phytobac in the T32 Exemption alongside the biobed and biofilter. As such, a Phytobac may deal annually with up to 15,000 litres of dilute waste spray liquids.

The effects of enhanced evaporation within a Phytobac will influence the size of unit required. This will depend on both the geographical location within the country and local site variations due to shading etc.

Evaporation varies throughout the UK depending mainly on sunlight and wind speed. It is usually higher in southern areas compared to more northerly parts of the country. Using 10 years of meteorological data from across the country **Bayer CropScience** has developed software which allows the surface area of a Phytobac to be calculated for any liquid loading.

This calculation takes into account the volume of sprayer washings through the year as well as the location of the farm, and provides three size choices depending on the Phytobac site. Access to this Phytobac Calculator is available through **Bayer CropScience** (**www.bayercropscience.co.uk**).
A typical output from this calculation for one example farm with a roofed filling area for 14,000 litres waste spray liquid per season is shown below:

Site Exposure	Open Site	Partially Shaded	Fully Shaded
Surface area of Phytobac required	29.6m^2	35.6m^2	41.5m^2

From the example above, in a partially shaded location, a Phytobac with a surface area of 35.6 m^2 is proposed. Using satisfactorily jointed concrete panels this led to a decision to build a Phytobac of 9.8 m x 3.85 m = 37.73m^2.

Phytobac Irrigation

Trickle tape

Efficient water distribution over the Phytobac surface is key and drip irrigation is recommended. Emitter spacing within the drip pipes should equal the pipe spacing, e.g. for a light soil this might be 0.4 x 0.4m. Best fit for the above example would suggest 9 pipes each of 9.8m long allowing for the header pipe. Thus 216 emitters were installed from 9 lines each with 24 emitters.
Emitter flows generally range from 1 – 2 litre/hour. Thus a pump could be sized to deliver sufficient volume at a pressure of approximately 7m head in the drip lines, with a 3m probable lift from an underground tank,
i.e. total pressure =10m head or 1 bar.

Over wetting can considerably limit the Phytobac's work and it is recommended that an irrigation approach of little and often is taken. Maintaining moisture conditions is key to bioremediation; the biomix optimum moisture content is 60-70% of its water holding capacity.

Biomix

This was developed as a mix by volume of 70% top soil and 30% straw (by weight 100kg soil requires 2-3kg of straw). The soil should be of a friable type to allow ease of mixing and good distribution throughout the system. Straw may be wheat or barley, ideally chopped to assist the mixing process. Simple mixing of the quantity required may take place on a concrete surface by layering straw and soil, then using a telehandler to mix the materials. Avoid using very large grab buckets or forks as these may bulldoze the material leading to a poor mix.

The mix may benefit from a standing time after mixing of 4-6 weeks, to allow the biomix to develop. When loading into the Phytobac avoid compaction and provide an even matrix loading throughout the tank.

Development of the Phytobac suggests that the biomix will have to be turned once per year with a top up of 15-20kg straw per m^3, to maintain the original volume. Therefore the roof should be easily removable to allow uncomplicated access.

The T32 Exemption granted by Environment Agency includes the requirement to exchange the biomix after 5 years. The 'old' mix must be stored under cover for a further year, so it is not subject to leaching. After this period it can be spread onto land at a rate not exceeding 50m^3 per hectare subject to the U10 exemption from the Environment Agency.

Operation

Loading a Phytobac with roof rolled back

Once installed, operation of the Phytobac should be simple. The transfer of liquid will be automatic and efficient distribution within the biomix should not cause problems.

As with any system it is a wise precaution, particularly in the early phase of adoption, to monitor the system, looking for silt build up, any pumping or irrigation issues or leaks. It is unlikely that there will be more than a weekly requirement out of spraying season to review the system, and this should only take a few minutes.

Whilst spraying, the operator will frequently be in close proximity to the system and will be aware of any changes as liquid volumes are transferred. Any plumbing or pumping issues which are found should however be attended to quickly, in view of the pollution potential of any spillage or leak.

As with a conventional biobed, any unvented exposed piping should be insulated to protect from frost damage.

Once a year, usually before the spraying season starts, the substrate should be turned to avoid compaction and to maintain good porosity. New straw can be added if a reduction of the substrate level is observed.

Costs

As Phytobacs can vary in size, type and materials used, it is extremely difficult to estimate total costs. The figures below are for general guidance only.

It may be that the bunded sprayer fill area already exists but where this needs to be constructed recent costs have varied between £2-3,000. Roofing the fill area is an additional cost and will vary on each site.

Assuming that an appropriately sized concrete Phytobac is installed with the necessary pumping and irrigation systems, construction costs may be around £7,000.

Dependant on future discussions and prioritisation of river catchments these costs may be subject to a Catchment Sensitive Farm Capital Grant (DEFRA: Water grants 2015: lined biobed with existing wash down area (RP25) Published 2.3.2015).

FAQ's

- **How many Phytobacs are operating?**

  There are currently circa 3,000 Phytobacs in operation across Europe in countires such as France, Germany, Netherlands, Belgium and the UK.

- **My farm is in a high rainfall area – above 800 mm annual rainfall, will the system have sufficient evaporation?**
  The Bayer Phytobac Calculator takes account of the volume of sprayer washings, as provided by the farm, and balances this with potential evaporation based on location. As a result the size of a Phytobac is tailored to each situation, and is as good as the supplied data. Roofing the fill area eliminates rainfall entering the system.

- **Do I have to contact my local Environment Agency to install a Phytobac?**
  Yes, it will be necessary to register a T32 exemption with the Environment Agency; this can be done online. However it would be wise to have preliminary discussions with your local Environment Agency to ensure there are no problems with any system or site chosen. You must discuss siting of a Phytobac with the Environment Agency where your site is within a Groundwater Source Protection Zone 1.

- **Are there any other limitations to siting?**
  Yes, all the restrictions which apply to biobeds and biofilters, which are included within Exemption T32 are also applicable to Phytobacs. In summary these are;
  Not within
  - *10m of a watercourse*
  - *50m where borehole used for non domestic / food purposes*
  - *250m where borehole used for domestic / food purposes*

- **Does the Phytobac need to be below ground**
  No, but many examples in France have shown that this is simple to adopt, install and manage. Elsewhere above ground concrete or plastic units have been developed. Small Phytobac systems have included plastic tanks containing the biomix under a polycarbonate roof.
  *Phytobac kits have been designed for local markets by Beutech (**www.beutech-agro.nl**) in the Netherlands, and Hermex (**www.hermex.fr**) and Biotisa (**www.biotisa.com**) in France.*

Further Information

- Biobeds, biofilters and best practice advice can be found through the Voluntary Initiative http://www.voluntaryinitiative.org.uk
- Government Regulations can be found at www.gov.uk
- To find out more on Catchment Sensitive Farming and find your local officer visit https://www.gov.uk/catchment-sensitive-farming-reduce-agricultural-water-pollution
- Information on the safe storage of pesticides can be found in the Health and Safety Executives Agriculture Information Sheet AIS16
- An introduction to biobed systems Phytobac Manual: Part One, an Introduction to Biobed system and Phytobac is found through www.bayercropscience.co.uk
- Groundwater Source Protection Zones information can be found at http://apps.environment-agency.gov.uk/wiyby/default.aspx

Glossary

Agricultural Waste Regulations: Waste exemption: T32 treatment of waste in a biobed or biofilter. GOV.UK: Part of Business, Waste environment, Environmental regulations. This exemption allows you to treat non-hazardous pesticide washings in a biobed or biofilter. The treated washings can be re-used and the biobed material (biomix) can then be spread on land (under an exemption) for agricultural or ecological benefit.

Anaerobic: An environment without air, reducing or stopping the rate at which contaminants are metabolised or broken down.

Biomix: An organic mixture (by volume) of 70% topsoil and 30% straw in a Phytobac and 50% straw, 25% friable soil and 25% compost in a Biobed.

Bioremediation: The breakdown of contaminants through microbial activity.

Carbon Filtration: A method to remove contaminants and impurities by filtering through a bed of activated carbon which traps the pollutant molecules.

Enhanced Evaporation: Reducing the amount of liquid in the biomix by exploiting the air flow and heat transfer created by the Phytobac roof.

Environmental Permit: Authorisation by the Environment Agency for businesses that produce waste emissions that pollute the air, water or land. GOV.UK: Part of Environment and countryside, Recycling and waste management.

Hot spots: areas on and around a sprayer and pesticide handling area where there is a high chance of leaks, drips or spills which could result in the release of contaminants.

Point Source Pollution: Pollution arising from an identifiable and localised area, structure or facility, such as discharge pipe, landfill or foil from a pesticide container.

Washings: contaminated water created from cleaning a sprayer after use.

Waste exemption: U10 spreading waste to benefit agricultural land. GOV.UK: Part of Business, Waste environment, Environmental regulations. This exemption allows you to spread specific waste on agricultural land to replace manufactured fertilisers or virgin materials such as agricultural lime used to improve or maintain soil.

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In addition **Bayer CropScience** contributed photographs from Orchard Farm in Great Chishill, Royston and other European sites.

Phytobacs in Europe

Concrete panel construction with rollable roof

Below ground construction with coated steel roof

Phytobac during irrigation

A Dutch preformed Phytobac

Bayer CropScience and **sustainable agriculture**

With a rapidly growing global population, crop protection and seeds have an increasing role to play in helping our farmers produce more food.
We are currently reinvesting more than 10% of our sales into developing new plant protection products, seeds and traits, keeping **Bayer CropScience** at the forefront of sustainable agriculture. This is combined with our extensive stewardship activities and a growing number of AgriServices such as pest forecasting systems and agronomy apps for smartphones and tablets.

The Phytobac system is one example of how **Bayer CropScience** looks to promote the very best in environmental stewardship and sustainable agriculture.
For more information visit our website or call Bayer Assist.

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