

Examples of results from the Ten Element Stack model

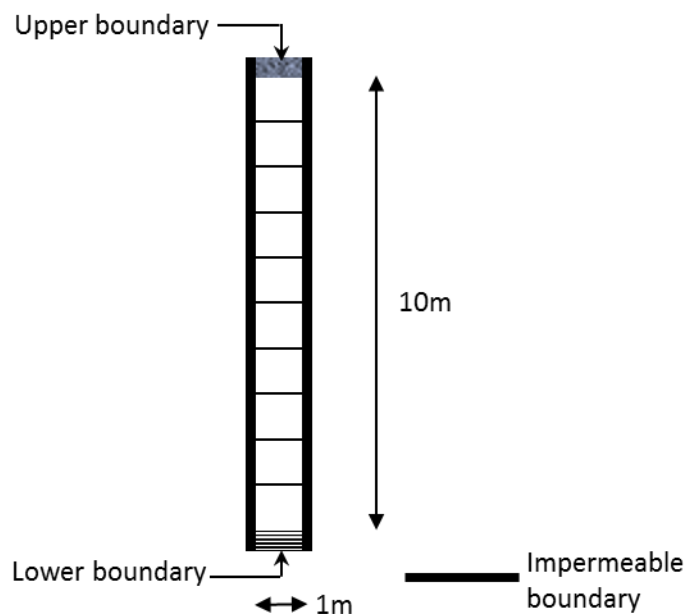
Running the standard Ten Element Stack model produces a Merged Results file which may be downloaded and used to create a user define Excel template of the results.

Advice on how to produce a results template may be downloaded from the Fast Track to using LDAT page. Click on 'Reference: Using a Results Template'.

As described below this model is set up to demonstrate simple passive waste degradation. It is then amended by making a few simple changes to the lower boundary element parameter values. The first amendment demonstrates leachate recirculation, and the second demonstrates aeration.

The three templates that are constructed for these examples may also be downloaded from the Fast Track to using LDAT page. Click on 'Template: 10_el_stack template – passive (or recirculation, or aeration)'.

1. Passive degradation Case



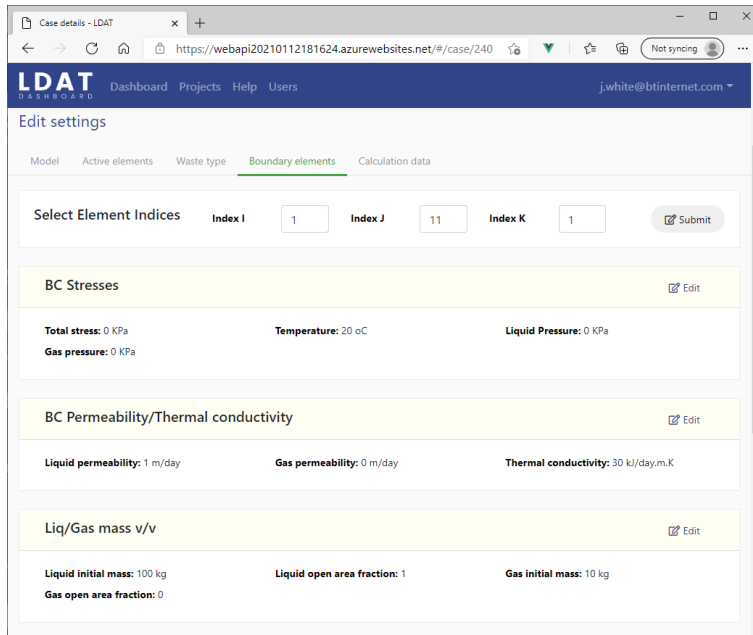
A diagram of the default Ten Element Stack model is shown above. To start with the results are for passive degradation and gas venting with the lower boundary permeable to liquid but not gas. Rainfall is simulated by using a transient boundary condition to pump a steady flow of 0.5 litres/m² per day from element [2, 1, 1] into the Upper boundary.

The boundary conditions applied to the lower boundary are shown in the screen shot below.

Further details of the boundary and initial conditions for this model are given in the note

Initial and Boundary Condition parameter values for LDAT landfill models.

This can be downloaded by clicking on the link in the LDAT website page Help\Get Started\Some results.



Download and open the Ten Element Model template containing the passive degradation results.

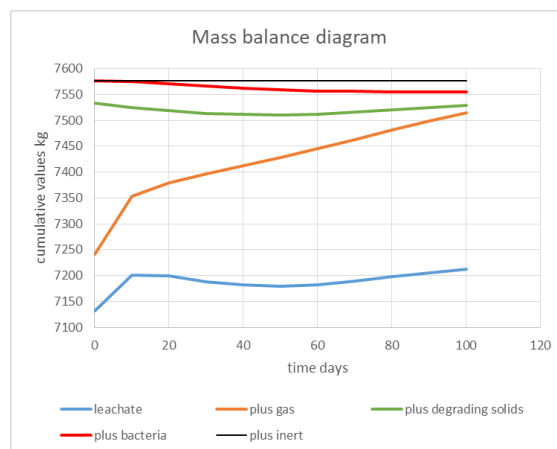
Sheet 1.0 LDAT Merged Results

The data on the first Sheet is simply a copy and paste of the data in the downloaded Merged Results file for this Case.

Sheet 1.1. Mass balance

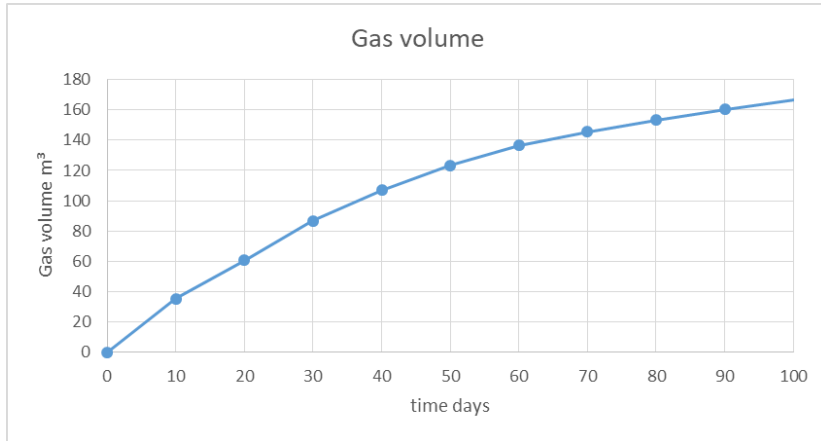
The second sheet has filtered data from the results which have been copied and pasted as Links to the first sheet. The advantage of pasting as Links is that when future results from this model are pasted over the results in the LDAT Merged Result Sheet 1.0, they will automatically be plotted.

Here the results have been selected to show the transient of the mass balance between all of the material phases in the model.



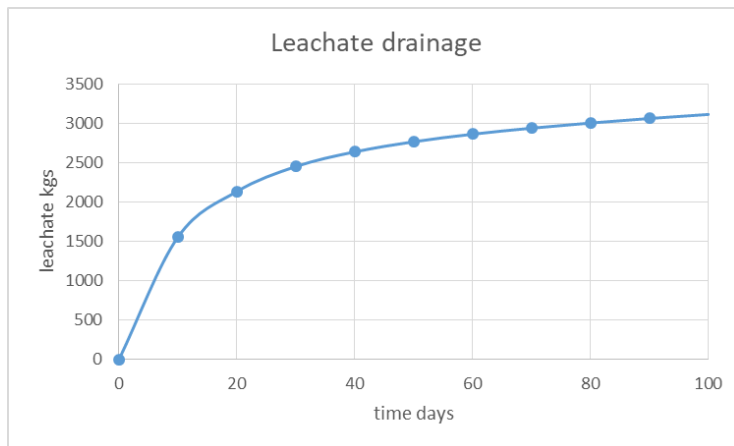
Sheet 1.2. Gas in upper boundary

This shows the venting response of all of the gas components in the upper boundary. The total volume curve is shown here.



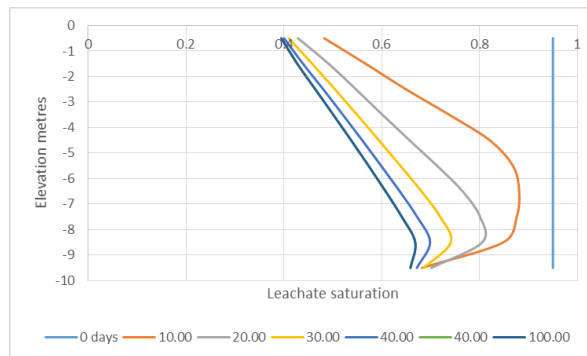
Sheet 1.3. Liquid in lower boundary

The initial condition of the leachate saturation in the elements is 0.9. The pressure in the lower boundary is zero relative to atmosphere. The drainage response in the lower boundary to these conditions is shown here where it can be seen that the leachate drains from the Stack.



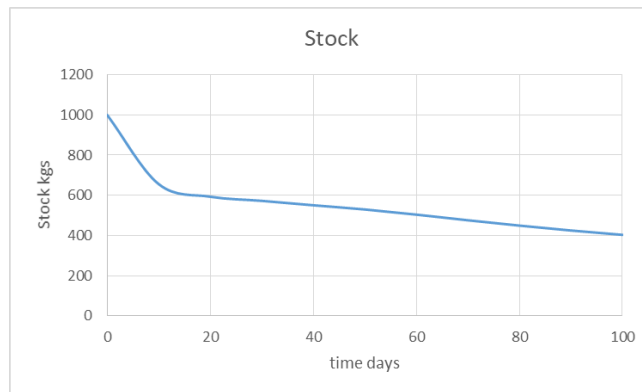
Sheet 1.4. Leachate profiles

The transient response of leachate saturation profiles in the Stack is shown here.



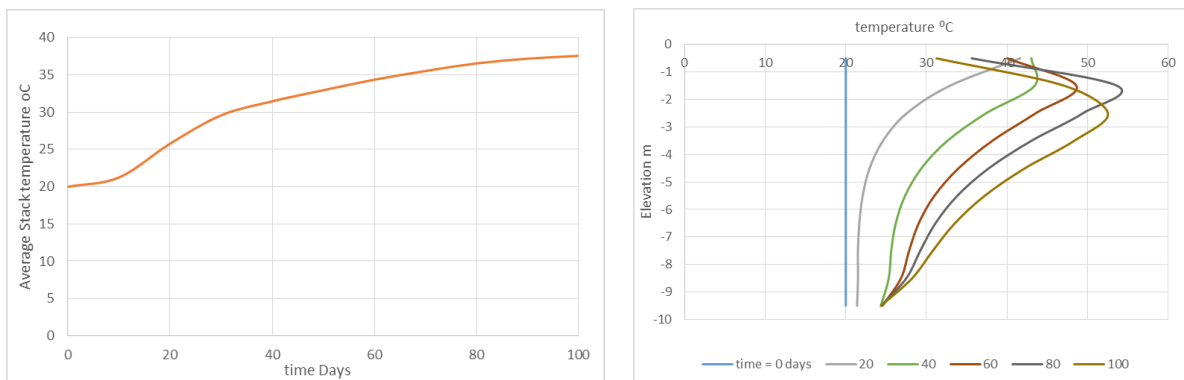
Sheet 1.5. Stock in upper boundary

The inert solid 'stock' transient in upper the boundary is shown here



This transient may be used to estimate the settlement in the waste as the result of changes in effective stress and the loss of solids as the result of degradation. In this case the Change in stock over 100 days is 597 kg and the change in solids amounts to 294 kg. The remaining settlement is due to compression as the result of increased effective stress, following drainage and the reduction of pore pressures. The final dry density in the upper active element was 422 kg/m³. The estimated settlement at this point would be calculated as $597/422 = 1.41\text{m}$.

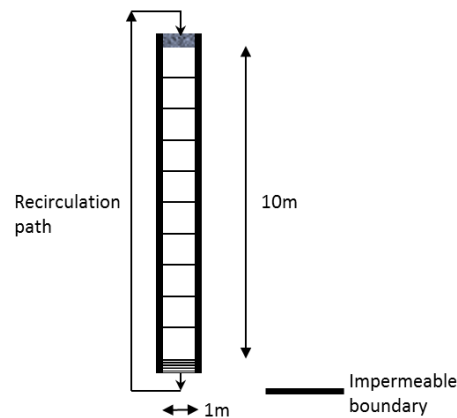
Sheet 1.6. Average Stack temperature and temperature profiles



The heating in the upper part of the Stack is due to the diffusion of oxygen from the upper boundary element feeding the aerobic degradation pathways.

For more results from the passive Ten Element Stack model refer to the additional links at the bottom of this document.

2. Recirculation Case



The Passive Case is now modified to create a new Ten Element Model to investigate the impact of introducing leachate recirculation between the lower and upper boundary elements by using a transient boundary condition. The recirculation starts after 20 days of passive degradation, after which 50 kg/day of liquid is pumped from the lower boundary element to the upper boundary element.

No changes are necessary to the lower boundary condition parameter values, as shown above, apart from the introduction of a two time interval transient boundary condition table.

The transient boundary condition looks like this.

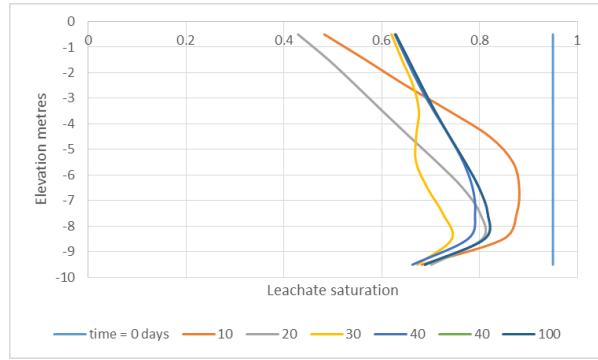
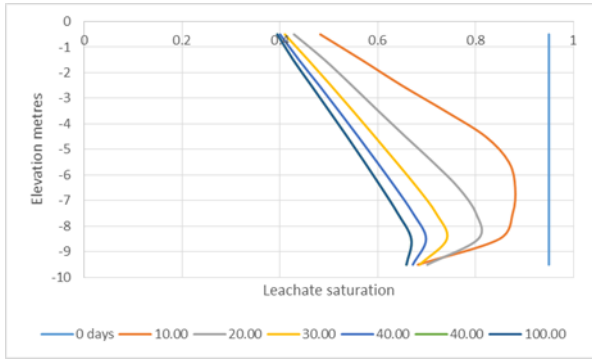
LDAT Dashboard Projects Help Users									
Update liquid fractions: <input type="checkbox"/>		Update gas fractions: <input type="checkbox"/>							
Transient boundary conditions									Edit
No. of time intervals: 2									
Time from	Time to	Gas pressure start	Gas pressure finish	Liquid pressure start	Liquid pressure finish	Gas flow rate	Liquid flow rate	Gas destination element	Liquid destination element
0	20	0	0	0	0	0	0	(0:0)	(1:0)
20	100	0	0	0	0	0	-50	(0:0)	(1:0)

BC Inert stock Edit

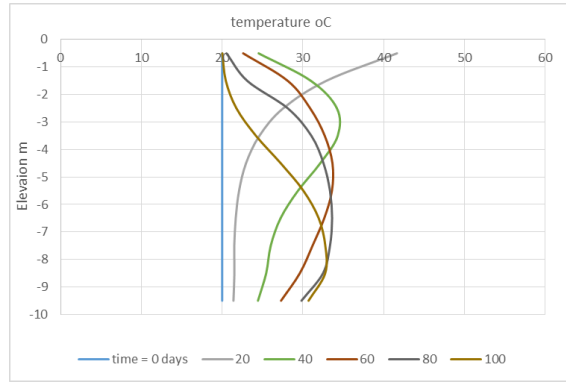
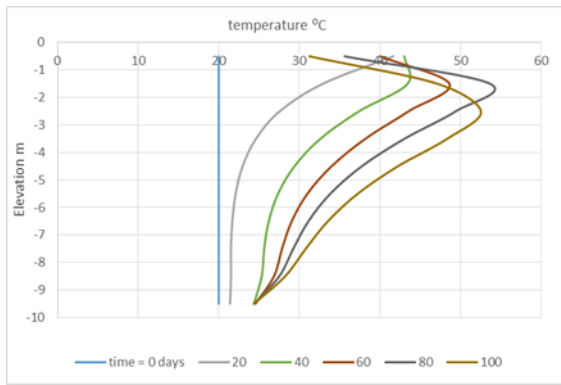
Mass of inert stock: 0 kg

The template is a copy of the Passive degradation Case template, but with the new recirculation Merged Results data pasted into the first Sheet.

The Figures below compare the leachate concentration profiles plotted in Sheet 1.4 of the passive Case and Sheet 2.4 of the recirculation case.

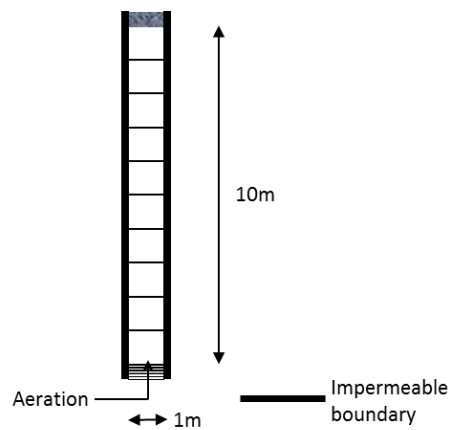


Temperature profiles are compared here.

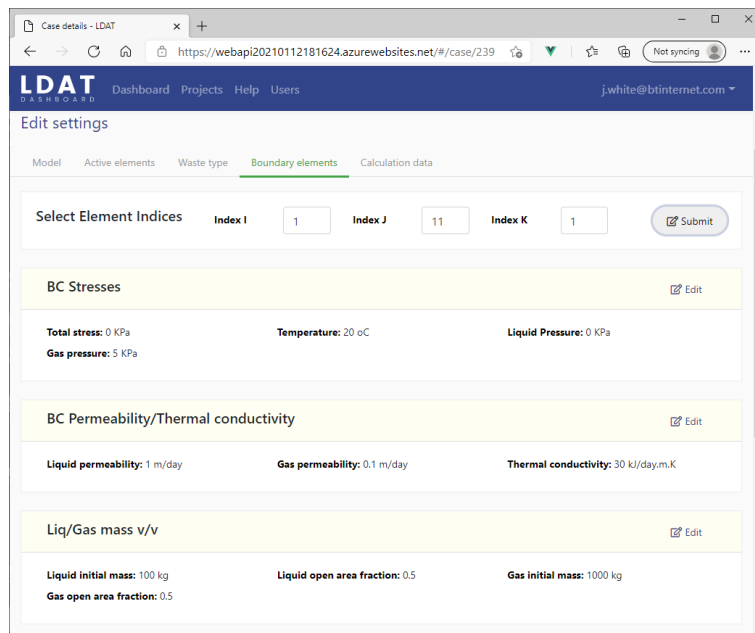


The recirculated leachate cools the upper part of the Stack and pushes the heated zone downwards.

3. Aeration Case

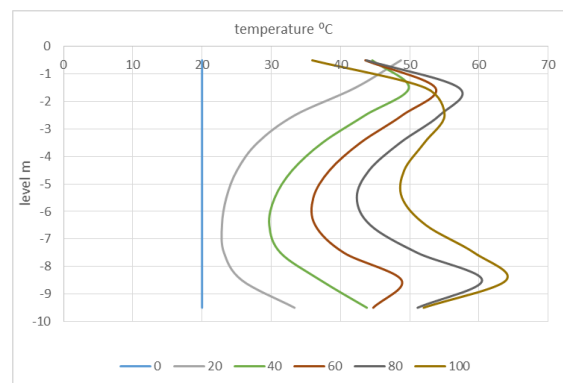
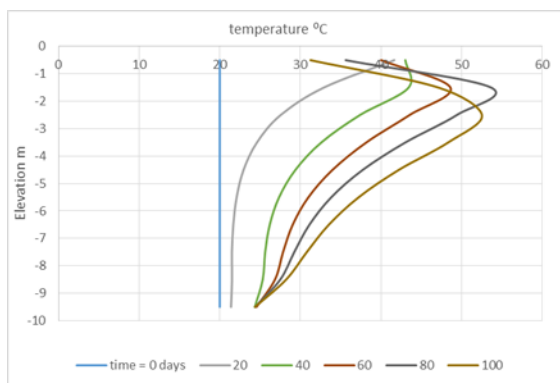
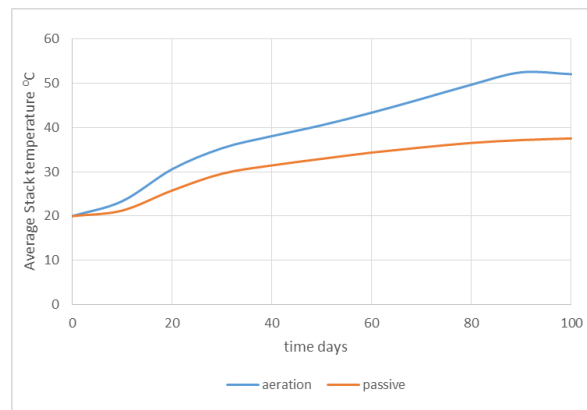


Another variation on the Passive Case is created by setting the permeability of the lower boundary to 0.1 m/day and setting the gas pressure to 5kPa. The boundary condition setting are show below.



Air is injected into the base of the Stack and simulates aeration.

Charts comparing the temperature transients with and without aeration are shown below.



More Results from the passive Ten Element Stack model

Further analysis of the results from the Ten Element Stack model are presented in the note **Gas and leachate emission results**. This note and the accompanying Excel Template, which provides details of the analysis, may be downloaded by clicking on the links in the LDAT website page Help\Get Started\Some results.

The purpose of the note is to focus on the gas and leachate emission data, which are two key areas of interest in the context of landfill management.

The results may be compared to the transient characteristics of key parameter values that have been observed in real landfills. Details of these are given in the note **Transient characteristics of gas and liquid components in real landfills** which is also available to download from the LDAT website page Help\Get Started\Some results.

As stated above, further information about the initial and boundary conditions that have been applied to configure the model that produced these results are given in the note **Initial and Boundary Condition parameter values for LDAT landfill models**. Most of these data values are accessible to the user through the data editor. The values for the built in configuration parameters that have yet to be made accessible are also provided.