Soil acidification

Intensification of a natural phenomenon

Explanation of the diagram "The magic of soil" sheet

Acidification of soil means an increase in its acidity level.

Soil acidifies naturally as a result of the effects of rain, microbial activity, sulphur from volcanic emissions and other factors. However, this process is accelerated and intensified by fallout of "acidifying" pollutants generated by certain human activities. Although soil has some ability to neutralise acidity, a problem arises if human input exceeds this natural neutralisation threshold. Acidification affects soil's biological activity and structure.

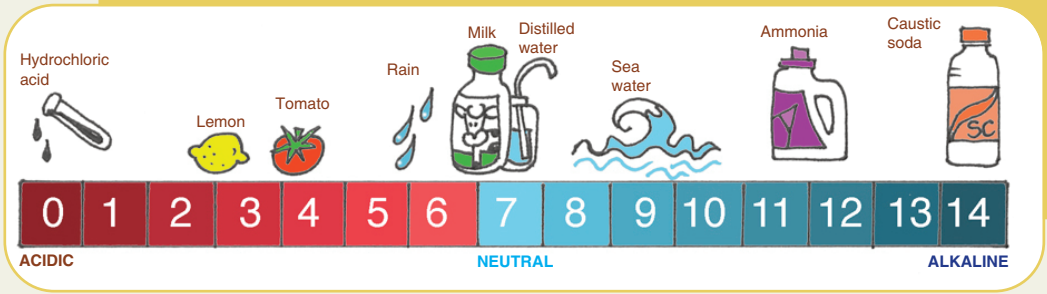
Sulphur dioxide (SO_2), nitrogen oxides (NO_x) and ammonia (NH_3) are the main causes of acidification. They are carried through the air and, some time later and after various complex chemical transformations, are deposited as "acid" rain or dust.

Since the 1990s, actions introduced at a regional, national and international level have succeeded in bringing about a major reduction in emissions of acidifying pollutants, including in Wallonia. This issue is therefore far less acute in comparison with twenty years ago, although efforts must continue.

This cross-section clearly shows the white upper soil horizon which has been leached of all its nutrients (carried down into the subsurface soil layers) and highly acidified.

What is acidity?

pH ("potential of Hydrogen") is a scale from 0 to 14 which is used to measure a substance's acidity.



Soil can be naturally acidic, alkaline or neutral.
Factors influencing its pH level include
- type of bedrock (limestone, sandstone, sand, for example)
- climate (rain and cold encourage acidity)
- vegetation (some plants which are more difficult for soil organisms to degrade result in the formation of more acidic humus).

Most of the soil found in Wallonia is acidic or neutral.

Human activities can also influence soil's acidity level, mainly through emissions of acidifying pollutants (increase pH) or the use of lime soil amendments (reduce pH).

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When soil becomes acidic...

1 Acid rain or dust falls onto soil and seeps into its surface.

2 Rain water quickly carries important nutrients (calcium, magnesium, etc.) to deeper levels of soil, out of reach of plants' roots.

3 Beyond a certain threshold (pH below 5.5), acidification triggers a release of the aluminium contained in soil. This is toxic for plants and causes them to wither.

4 If soil contains trace metal elements ("TMEs", formerly "heavy metals") such as cadmium, lead or zinc, these become more mobile and more easily assimilated by plants. The food chain can then become contaminated.

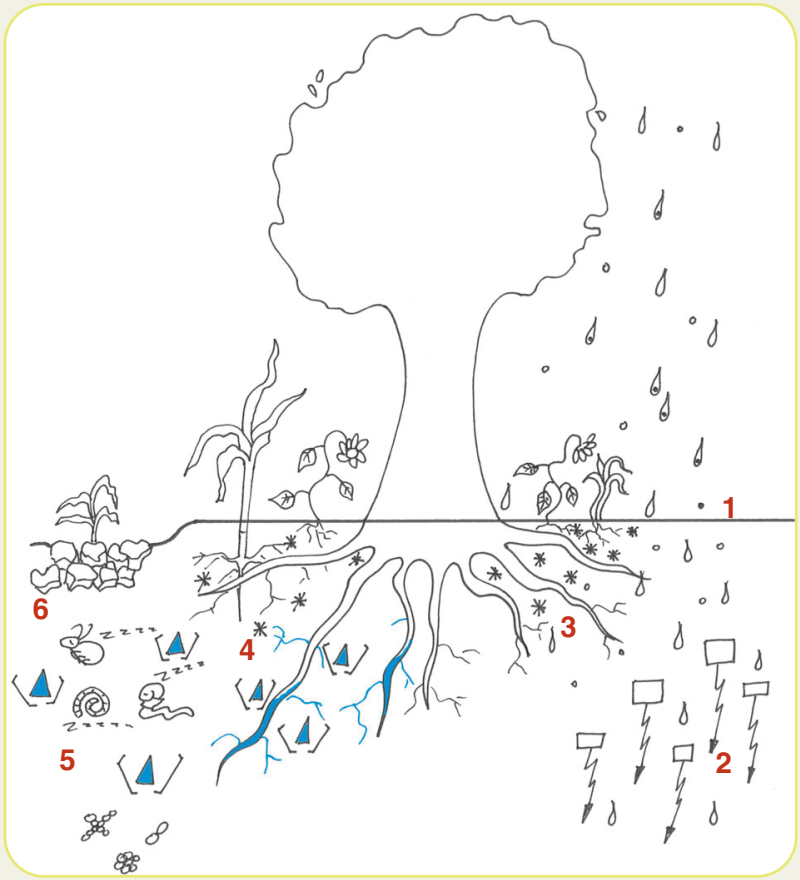
Sheet no. 5 "Local pollution"

5 The activity of earthworms and soil micro-organisms is inhibited. As a result, organic matter is degraded less quickly and efficiently. It is no longer decomposed or mineralised correctly into nutrients which can be assimilated by plants.

Sheets no. 3 and 4 "Organic matter" and "Biodiversity"

6 Soil's structure is affected, it becomes more vulnerable to erosion and less fertile.

Sheet no. 1 "Erosion"



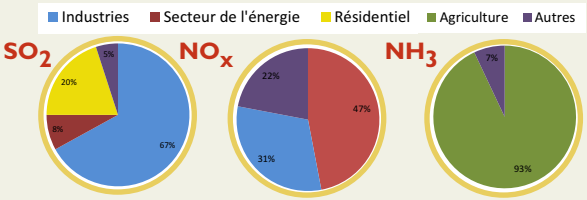
Consequences of soil acidification

- Acid rain
- Nutrient carried into soil
- Aluminium
- Released TMEs

Main sources of emissions of acidifying substances in Wallonia

SO_2: industry (67%), energy sector (8%), residential (20%)
NO_x: road transport (47%), industry (31%)
NH_3: agriculture (93%), other (7%)

Source: according to AWAC, 2010

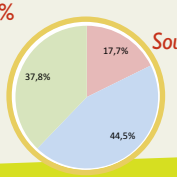


SO_2 and NO_x originate mainly from combustion phenomena (industry, transportation, electric power stations, residential heating), while the main source of NH_3 releases is livestock farming (degassing and spreading of manure and slurry).

Each pollutant's contribution to acidifying emissions in Wallonia

SO_2: 17,7%
NO_x: 44,5%
NH_3: 37,8%

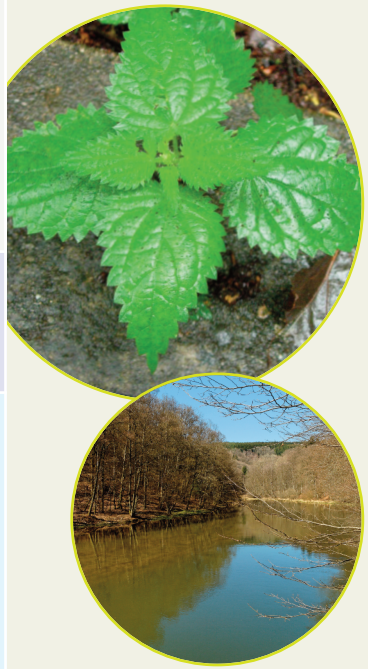
Source: according to AWAC, 2010



Not all soil is equal when it comes to acid precipitation.
Limestone soil, which is alkaline, tolerates acid precipitation better because limestone neutralises the acidity. On the other hand, the higher soil's level of acidity, the less capable it will be of neutralising inputs of acidifying substances. Soil with a medium to high acidity level (pH below 5.5) is therefore the most vulnerable.

Some other effects of acid pollutants

Soil Sheet no. 3 "Organic matter"	Inputs of ammonia and nitrogen oxides enrich soil and encourage "nitrophilous" plants but have adverse effects on plants less able to tolerate environments overly rich in nutrients. This issue becomes critical in certain so-called "poor" environments, where nitrogen inputs endanger a specific flora that develops there. This enrichment can also bring about imbalances in soil.
Groundwater reserves	Rain water carries nitrogen depositions into the soil, where they then contaminate groundwater bodies (nitrates).
Watercourses and water bodies Sheet no. 6 "Diffuse pollution"	Acidifying pollutants affect watercourses and water bodies, with negative consequences on aquatic life and environments. Deposition of nitrogen pollutants can contribute to the eutrophication* of watercourses. * Eutrophication: proliferation of algae in a watercourse or water body further to excessive inputs of nutrients (nitrogen, phosphorus, etc.).
Human health	Nitrogen oxides are precursors to the formation of atmospheric ozone (cf. "ozone peaks" in summer). This type of ozone causes respiratory problems, inter alia.
Vegetation	Direct contact with acid pollutants damages plants' foliage.
Buildings and construction	Acid rain damages buildings, monuments and other structures (particularly limestone) and corrodes metal components.

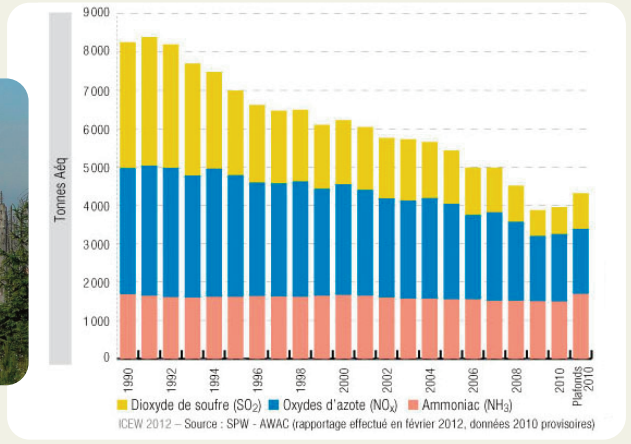


Efforts in Wallonia

Between 1990 and 2010, Wallonia **succeeded in reducing its emissions of acidifying pollutants by 52%**. During this same period, the surface area of forest in Wallonia affected by acidification fell from 90% to less than 10%. This reduction can be attributed to various factors: reduction of sulphur content in diesel and heavy fuel oils, greater use of natural gas, introduction of more efficient boilers and burners, catalytic converters fitted in cars, improvements in industrial processes and monitoring of emissions.

Wallonia is in line with the European average and adheres to the current caps for emissions of acidifying pollutants set by the European Directive, with the exception of nitrogen oxides* (NO_x): efforts must therefore continue, in particular as European standards may soon introduce even stricter requirements. However, the greatest concern in relation to ammonia and nitrogen oxides at the moment is their eutrophication effects rather than their acidifying consequences.

*Exceeded by 4%



Atmospheric emissions of acidifying substances in Wallonia. Comparison with emission caps set for 2010.
Source: ICEW 2012, p.69

Individual actions

Like most other forms of air-borne pollution that travel for long distances, the problem of acidifying pollutants is an issue that affects continents, even the entire planet. This does not mean that there is nothing we can do as individuals. Two of the main sources of acidifying pollutants are road transport and residential heating.

Three actions...

1 **Avoid taking the car** for short journeys. A catalytic converter reduces emissions of acidic substances, but it only becomes effective after around 15 kilometres. Most journeys are less than this. Continuous increases in traffic volumes are tending to cancel out the progress achieved through the installation of catalytic converters. The best solution is to leave your car in the garage as much as possible.

2 Buy a **more efficient boiler**.

3 Make sure that your home is **properly insulated**.

Bibliography

General publications by the SPW – online information

Les Indicateurs Clés de l'Environnement Wallon 2012 (ICEW 2012), Direction de l'Etat Environnemental, SPW Éditions - DGARNE - DEMNA - DEE, 2013 (available for download in French, English and German)
http://etat.environnement.wallonie.be

Tableau de bord de l'environnement wallon 2010, (*AWAC*) SPW Éditions - DGARNE – DEMNA - DEE, 2010 (available for download in French, English and German)
http://etat.environnement.wallonie.be

Rapport analytique sur l'état de l'environnement wallon 2006-2007, MRW – DGRNE, Namur, 2007 (available for download in French, English and German) "Les polluants acidifiants dans l'air", pp. 322 ssq. - Scientific report (available for download)
http://etat.environnement.wallonie.be

Environmental review of companies in Wallonia

Acidifying atmospheric emissions from the chemical, non-metallic mineral and metallurgy industries, etc.
http://environnement.wallonie.be (companies - reports and publications)

Key facts about acidification

Plan Air Climat
http://airclimat.wallonie.be

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