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Photochemical smog contains Ozone (O_3), a powerful oxidising agent. Ozone is formed when sunlight shines on primary pollutants.
A primary pollutant is a pollutant released directly into the atmosphere. For example the primary pollutant NO_x is emitted from vehicle exhausts and contains 95% NO and small amounts of NO_2. [1]
Ozone is what we call a secondary pollutant because it is formed when primary pollutants undergo further reactions.
Other constituents of photochemical smog are given below.

Living organisms contain sulphur compounds and because coal is formed from the gradual compacting of partially decomposed plant matter [3], coal also contains sulphur compounds. When the coal is burnt the sulphur compounds are converted to oxides of sulphur, which are primary pollutants.
Also proteins in the organisms contained Nitrogen compounds and when the coal is burnt these are oxidised to form NO_x, and at high temperatures used for combustion Nitrogen and Oxygen in the air combine to form thermal NO_x. Both of which are primary pollutants. [4]

Photo chemical smog forms in high pressure conditions in the lower troposphere. These conditions also produce still air so there is little mixing between high altitude air. As a result of this, the smog gets trapped near the ground where wind often transports it to rural areas.

One way of forming Ozone is when an oxygen molecule reacts with an Oxygen radical:

$$O_2 + O \rightarrow O_3$$

Oxygen radicals are formed when sunlight energy is absorbed by N O2 molecules:

$$NO_2 \xrightarrow{h\nu} NO + O$$

So a lot of sunlight is a favourable condition for forming photochemical smog. This explains why photochemical smog is generally a summer event in the UK.
O3 is one of the ingredients that react to produce photoch emical smog but its concentration increases during the formation:

$$\text{One } O_3 \text{ molecule} \xrightarrow{\text{Photochemical smog formation}} \text{At least two } O^3 \text{ Molecules}$$

This is because of OH radicals involved in the breakdown of Hydrocarbons; they remove H atoms from molecules E.g. in the breakdown of Hydrocarbon.

$$RCH_3 + OH \rightarrow RCH_2 + H_2O$$

$$RCH_2 + O_2 \rightarrow RCH_2O_2$$

RCH_2O_2 then reacts with NO:

$$RCH_2O_2 + NO \rightarrow RCH_2O + NO_2$$

This reaction has converted NO back into NO_2 which can be used in the reaction that forms O radicals that form O_3.

$$NO_2 \xrightarrow{h\nu} NO + O$$

$$O_2 + O \rightarrow O_3$$

The OH radicals are formed from the following reactions:

$$O_3 \xrightarrow{h\nu} O_2 + O$$

$$O + H_2O \rightarrow 2OH$$

So because one ozone molecule reacts to form two OH molecules, the ozone concentration increases during the production of photochemical smog.[5]

At Logannet the BPEO chosen to reduce SO_X emissions is the sea scrubbing process.
Flue gases are passed through sea water which naturally has a pH of about 7.5 the sulphur dioxide dissolves to form sulphite ions.
The water is aerated to oxidise these further to sulphate ions which are better for disposing of back into the sea.
The pH usually changes to about 6 but when it is returned to the sea the change is negligible.

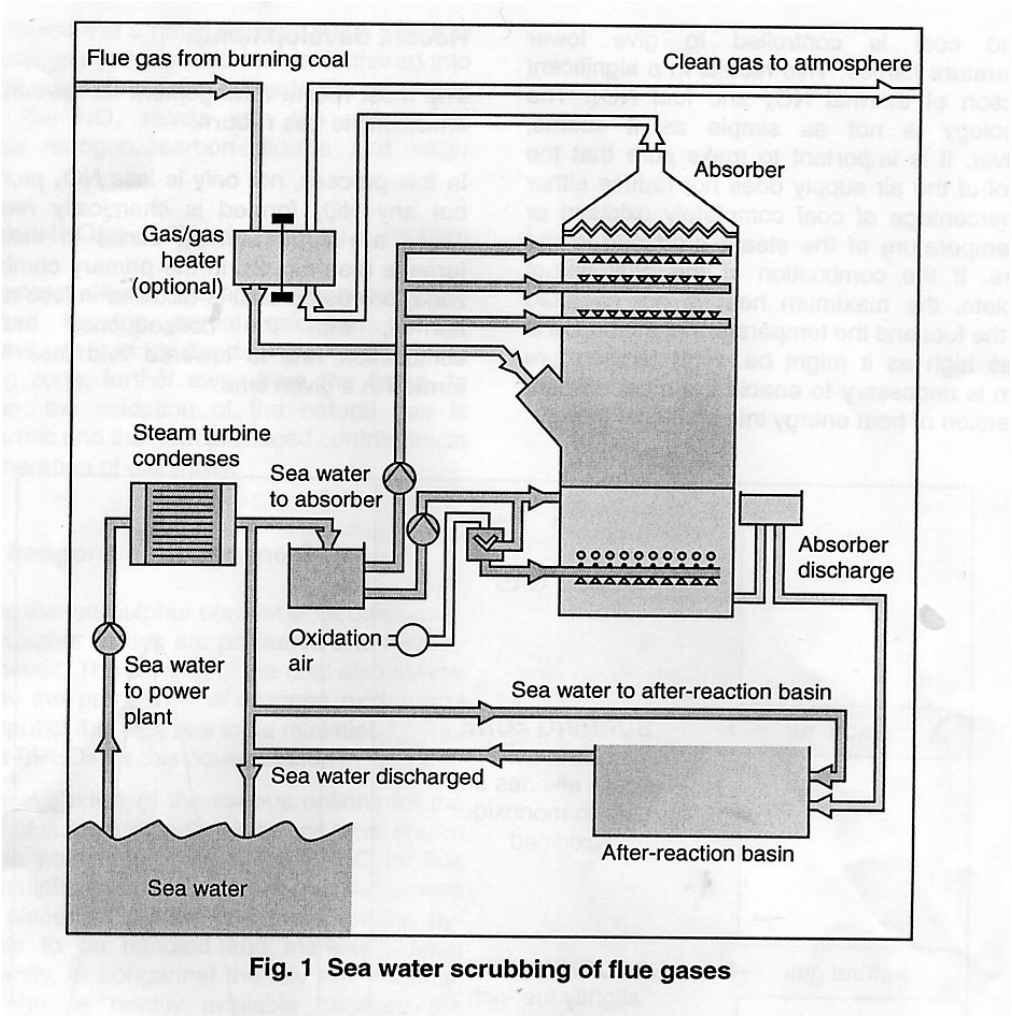

Fig. 1 Sea water scrubbing of flue gases

Logannet found this process the BPEO because there are no solid wastes produced, no by-products to be handled and the sea water needed is very available because logannet is situated on the bank of the firth of forth.

The BPEO chosen to reduce NO_X emissions at logannet is the most recent development.
There are 3 burning zones in the boiler furnace.
Primary combustion zone
Powdered coal is oxidised in less air than is normally used so the combustion rate is lower and less NO_x is formed in a given time.
Reburning zone
Natural gas is injected into the boiler. The NO_x reacts with the alkanes to produce Nitrogen, Carbon dioxide and water vapour.

$$CH_4\,(g) + 4NO\,(g) \rightarrow 2N_2\,(g) + CO_2\,(g) + 2H_2O\,(g)$$

Burning zone
Any excess alkane or CO produced is oxidised.

Research is still taking place to explain the complex chemistry involved in photochemical smog formation
Chemists are monitoring tropospheric pollutants to find what pollutants are present and how their concentrations vary. There are several monitoring stations across the country.
Individual reactions are also being studied in laboratories to find out what reactions can take place and how quickly they occur much of this work is done in computer simulation studies to reproduce the behaviour of pollutants in a photochemical episode.

We can also do laboratory experiments of a larger scale in smog chamber simulations.
Primary pollutants are mixed together in a clear plastic bag called a smog chamber and exposed to sunlight. Probes monitor the concentration of various species as the smog builds up.[8]