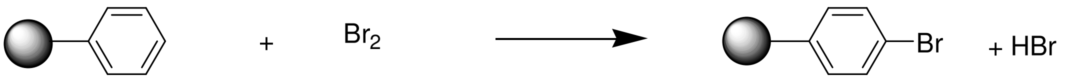
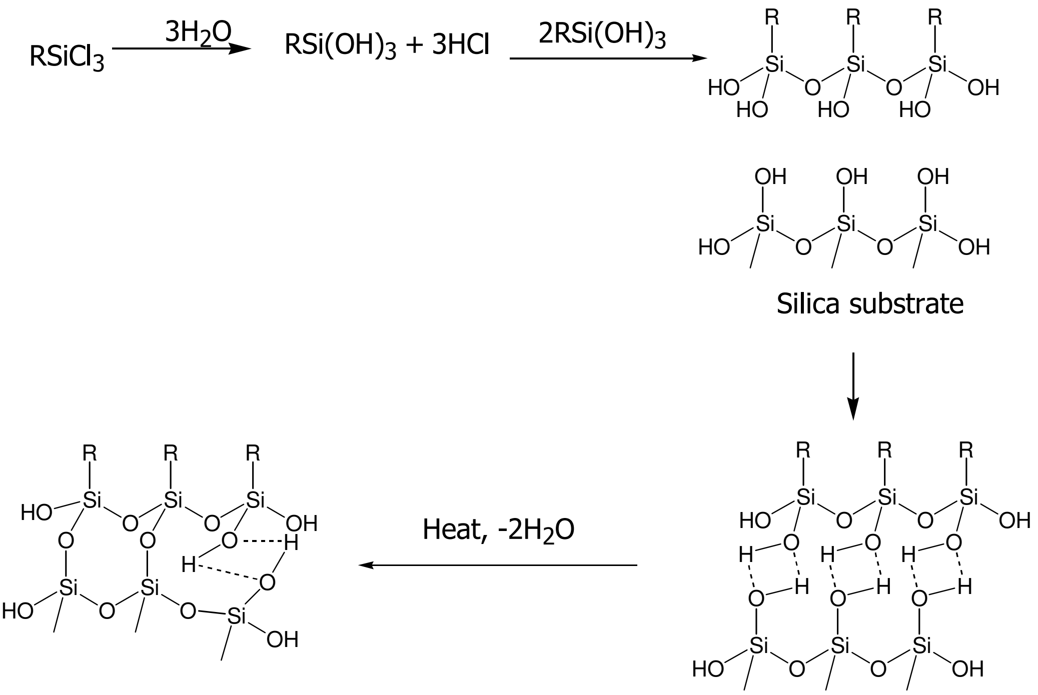
Appendix 2: Technical Information

1) Bromination of organic polymers



The reaction here is the addition of bromine to the aromatic ring of a polystyrene polymer, catalysed by thallium (III) acetate to ensure reaction in the *para* position of the ring. This reaction is carried out at room temperature and pressure in 2.4Kg batches in a closed glass reaction vessel housed in a bunded fume cupboard under conditions defined by an ISO 9001:2008 work instruction. Loading and unloading of the reactor vessel is carried out with fume extraction. After an overnight reaction the mixture is heated to 75^{0}C to drive off the reaction by–product, hydrogen bromide, and the product is washed *in situ* before drying under vacuum. The emissions from this reaction are principally hydrogen bromide, along with some fugitive emissions of VOCs (solvents used for purification), but there is no active abatement system as the emissions are below the levels required for a low impact installation (reference H1v2_4_Biotage 2). Fume extraction is installed under primarily under Control of Substances Hazardous to Health (COSHH) regulations, Health & Safety at Work Act 1974. Waste solvent is consolidated and collected by Environmental Resource Group.

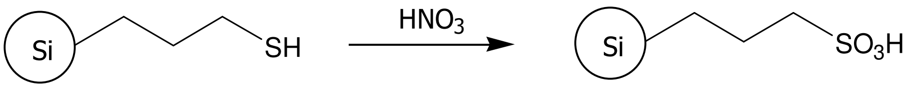
2) Chlorosilation



The reaction here is the addition of an organic chlorosilane to the surface of a silica particle, catalysed by imidazole. This reaction is carried out at 58^{0}C and atmospheric pressure in batches ranging from 1Kg to 12Kg in a closed glass reaction vessel housed in a bunded fume cupboard under conditions defined by an ISO 9001:2008 work instruction. Loading and unloading of the reactor vessel is carried out with fume extraction. After an overnight reaction the mixture is washed *in situ* before drying. The emissions from this reaction are principally hydrogen chloride, along with some fugitive emissions of VOCs (solvents used for purification), but there is no active abatement system as the emissions are below the levels required for a low impact installation (reference H1v2_4_Biotage 2). Fume extraction is installed under primarily under Control of Substances Hazardous to Health (COSHH) regulations, Health & Safety at Work Act 1974. Waste solvent is consolidated and collected by Environmental Resource Group.

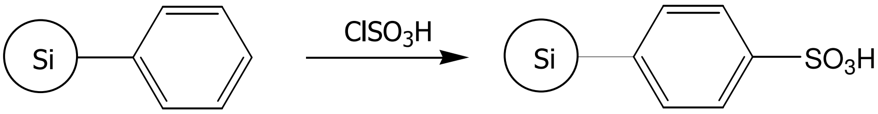
A variation of this reaction involves using an alkoxysilane in place of the chlorosilane. The by product in this case is methanol, removed in the purification process.

3) Oxidation of Si – Thiol



The reaction here is the oxidation of the thiol group on a bonded phase sorbent (prepared via the reaction above) with dilute nitric acid. This reaction is carried out at 50^0C and atmospheric pressure in 6 – 7Kg batches in a closed glass reaction vessel housed in a bunded fume cupboard under conditions defined by an ISO 9001:2008 work instruction. Loading and unloading of the reactor vessel is carried out with fume extraction. After an overnight reaction the product is washed extensively before drying. The emissions from this reaction are oxides of nitrogen, mainly as NO_2, along with some fugitive emissions of VOCs (solvents used for purification), but there is no active abatement system as the emissions are below the levels required for a low impact installation (reference H1v2_4_Biotage 2). Fume extraction is installed under primarily under Control of Substances Hazardous to Health (COSHH) regulations, Health & Safety at Work Act 1974. Waste solvent is consolidated and collected by Environmental Resource Group.

4) Sulphonation of sorbents



The reaction here is the sulfonation of the aromatic ring of a bonded phase sorbent using chlorosulfonic acid in dichlromethane. This reaction is carried out either at room temperature or at 40^{0}C and atmospheric pressure in 2 – 3Kg batches in a closed glass reaction vessel housed in a fume cupboard under conditions defined by an ISO 9001:2008 work instruction. Loading and unloading of the reactor vessel is carried out with fume extraction. After an overnight reaction the reaction is quenched by pouring the mixture on to ice. The product is washed thoroughly before drying. The emissions from this reaction are principally hydrogen chloride, along with some fugitive emissions of VOCs (solvents used for purification). A small, laboratory size scrubber is used during the reaction to minimise the local effects of the HCl, but there is no active abatement system as the emissions are below the levels required for a low impact installation (reference H1v2_4_Biotage 2). Fume extraction is installed under primarily under Control of Substances Hazardous to Health (COSHH) regulations, Health & Safety at Work Act 1974. Waste solvent is consolidated and collected by Environmental Resource Group.