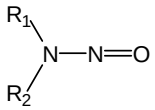
WHAT ARE N-NITROSAMINES?

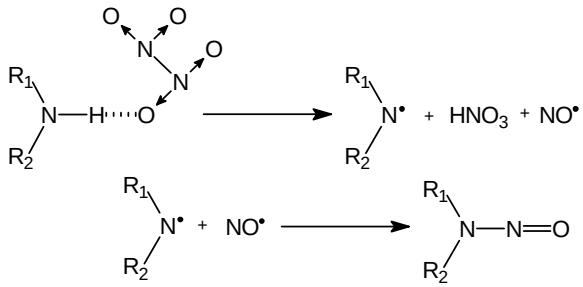
N-nitrosamines are derivatives of amines with nitroso group (N=O) bonded to the nitrogen of the corresponding amine.



R_1, R_2: alkyl, aryl

HOW ARE N-NITROSAMINES FORMED?

N-nitrosamines are formed by the reaction of secondary amines with nitrogen oxides as nitrosating agent. The possible reaction mechanism for the formation is presented as follows:



POSSIBLE EFFECTS OF N-NITROSAMINES ON HUMAN HEALTH

N-nitrosamines have been shown to be carcinogens in animals producing liver, kidney and lung cancer. The carcinogenic activity is probable dependent on the alkylation ability of carbenium ion (R_1^+ or R_2^+). IARC (International Agency for Research on Cancer) classification as probable human carcinogen has emerged.

THE LEGISLATION WHICH CONTROLS THE LIMITS OF N-NITROSAMINES

The IARC's classification has obliged rubber manufacturers and processors to provide for their effective control. The current legislation regarding limits of N-nitrosamines is presented in next table.

Current legislation	Limit
BGA, EU Directive 93/11/EEC	10 ppb (µg/kg) for total N-nitrosamines and 200 ppb for nitrosatable materials
FDA	10 ppb for any one N-nitrosamine within a maximum total N-nitrosamine level at 60 ppb
TRGS 552	2.5 µg/m^3 airborne N-nitrosamines around manufacturing and storage areas and 1 µg/m^3 elsewhere

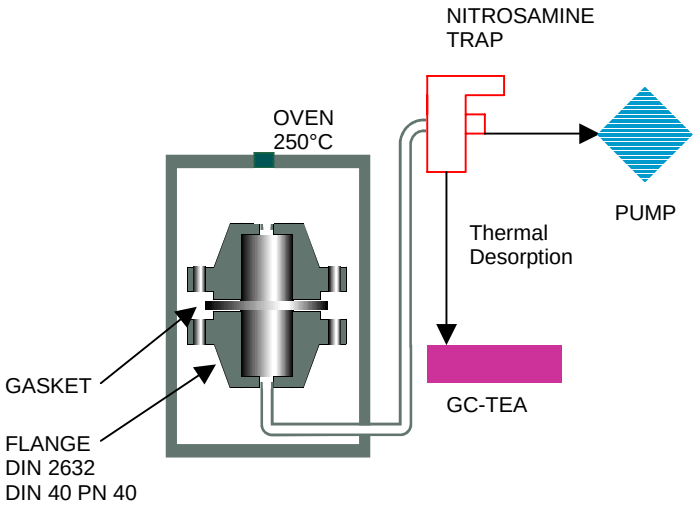
N-NITROSAMINES AND THE SEALING MATERIAL

Secondary amines which are precursors for N-nitrosamines and nitrosating agents (NxOy) may be present in/on elastomers, fillers and other compounding ingredients of the sealing material. During vulcanization and postvulcanization thermal treatment these contribute to the formation of additional N-nitrosamines which are also generated by the decomposition of certain rubber accelerators.
N-nitrosamines are formed also close to the surface of the material during storage, assembly or service.

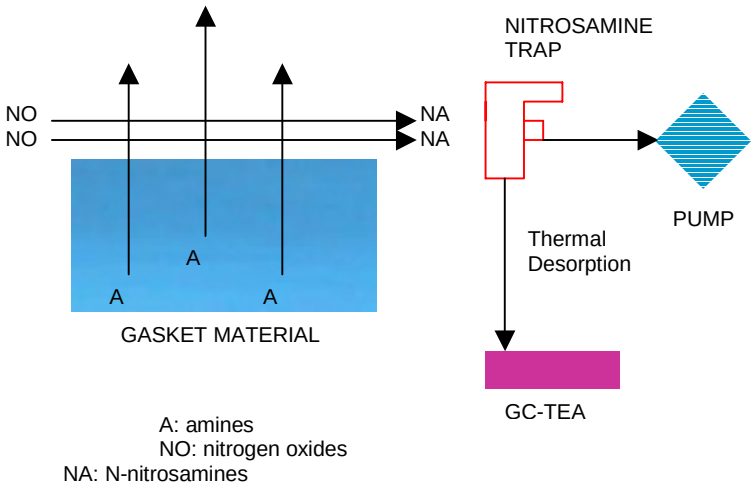
DETERMINATION OF N-NITROSAMINES

The amount of N-nitrosamines contained in sealing materials can be determined by extraction method of the material with dichlormethane or artifical saliva. N-nitrosamines emitted from the sealing material under the working conditions (Figure 1) and airborne N-nitrosamines are determined by thermal desorption method of trapped N-nitrosamines (Figure 2). The detection of N-nitrosamines is carried out by means of Gas Chromatography – Thermal Energy Analyser (GC-TEA).

Determination of N-nitrosamines from the gasket under working conditions



Determination of airborne N-nitrosamines



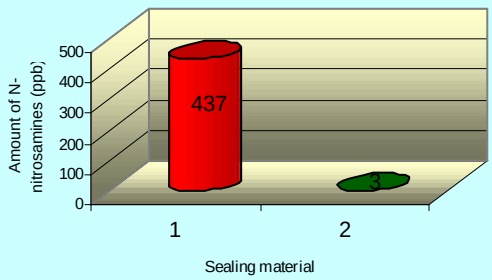
A: amines
NO: nitrogen oxides
NA: N-nitrosamines

EKO SEALING MATERIALS

EKO generation of sealing materials produced as environmental friendly sealing materials are nitrosamine free and free of hazardous fibres. When they are applied at higher temperature no emmision of dangerous degradation products is detected above permitted level.

RESULTS OF DETERMINATION OF N-NITROSAMINES

Amount of N-nitrosamines of the reference sealing material 1 and EKO sealing material 2



Amount of N-nitrosamines emitted from the reference sealing material 1 under working conditions, amount of airborne N-nitrosamines of the reference sealing material 2 and amount of N-nitrosamines emitted from EKO sealing material 3 under working conditions, amount of airborne N-nitrosamines of EKO sealing material 4