Tetrafluoroethylene-Propylene Rubber

1. INTRODUCTION

Since the advent of vinylidenefluoride-hexafluoropropylene based elastomer in the 1950s, a variety of fluoroelastomers have been developed and commercialized.

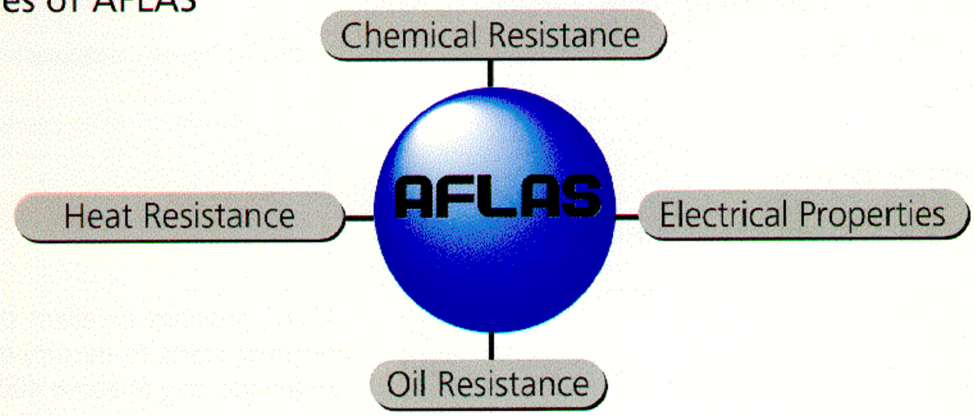
In 1975, a new fluoroelastomer family, which is based on an alternating copolymer of tetrafluoroethylene and propylene, was introduced by Asahi Glass Co., Ltd., under the trade name AFLAS. The elastomer is unique in that it offers (1) excellent heat resistance with maximum continuous-service temperature of about 230°C and above, (2) distinguished chemical resistance with no or little deterioration even in contact with strong acids and bases at high temperature, and (3) high electrical resistivity of the order of $10^{15} \sim 10^{16} \Omega \cdot cm$.

The elastomer has been distributed worldwide and is used in a wide variety of industrial fields where rubber parts meet harsh environments.

Reflecting the recent trend of increasing power of automobile engines, temperature of the engine becomes higher and high performance engine oils which are heavily formulated with amine-based additives come to be used. In such a field, elastomer parts are required to have more heat resistance and engine oil resistance even if a fluoroelastomer is used. Therefore, AFLAS has been attracting more attention as a material which meets such harsh conditions. On the other hand, AFLAS has been finding new applications in wire and cable industries as an elastomeric insulating material with the highest heat resistance.

AFLAS is now mainly used in automotive industries as oil seals and in wire and cable industries as insulation jacketing.

●Features of AFLAS

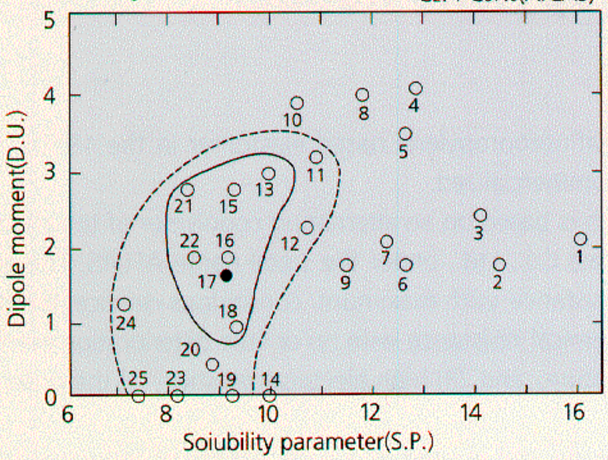


●Structure of AFLAS

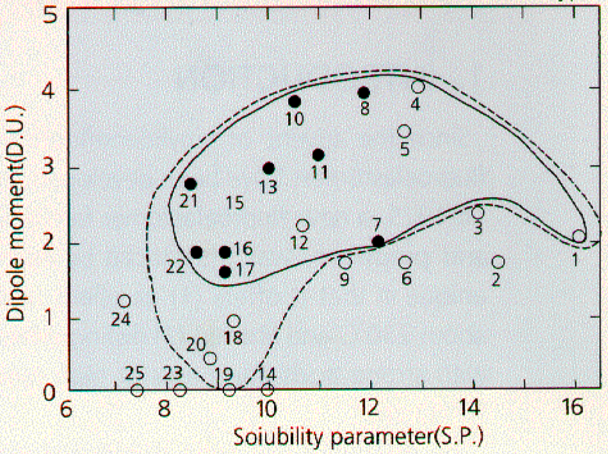
AFLAS 100, AFLAS 150	$-(CF_2CF_2)_m-(CH_2CH(CH_3))_n-$	Chemical Resistance Heat Resistance Electric Insulation
AFLAS MZ201 **AFLAS SP**	$-(CF_2CF_2)_l-(CH_2CH(CH_3))_m-(CH_2CF_2)_n-$	Chemical Resistance Heat Resistance Low Temperature Flexibility
FKM	$-(CH_2\text{-}CF_2)_x-(CF_2\text{-}CFCF_3)_y-$	(VdF-HFP)
	$-(CH_2\text{-}CF_2)_x-(CF_2\text{-}CFCF_3)_y-(CF_2\text{-}CF_2)_z-$	(VdF-HFP-TFE)

●Solubility

C_2F_4-C_3H_6(AFLAS)



CH_2CF_2-C_3F_6type



The above numbers correspond to the following solvents.

1 HCONHCH3	6 C_2H_5OH	11 $CH_3COCH_2COCH_3$	16 $CH_3COOC_2H_5$	21 $CH_3(i\text{-}C_4H_9)CO$
2 CH_3OH	7 $HCON(CH_3)_2$	12 C_5H_5N	17 C_4H_8O	22 CH_3CCl_3
3 HOC_2H_4OH	8 CH_3CN	13 $(CH_3)_2CO$	18 C_2HCl_3	23 c-C_6H_{12}
4 $(CH_3)_2SO$	9 n-C_4H_9OH	14 CS_2	19 C_6H_6	24 $(i\text{-}C_3H_7)_2O$
5 CH_3NO_2	10 CH_2CHCN	15 $CH_3(C_2H_5)CO$	20 $C_6H_5CH_3$	25 n-C_7H_{16}

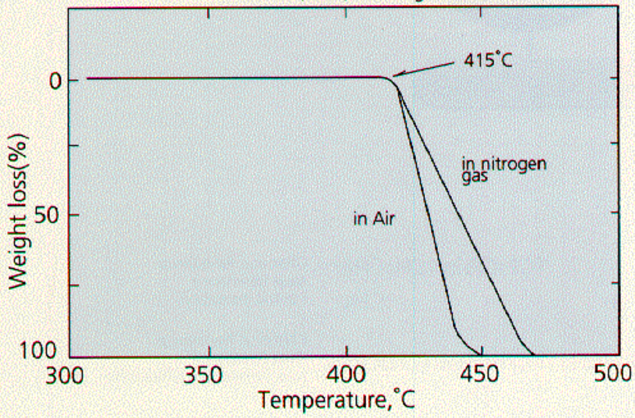
Mastication of the polymer and stirring above room temperature makes AFLAS soluble in tetrahydrofuran (17). Though the polymer swells in low-polar chlorine or aromatic solvents, it swells only negligibly in solvents with solubility parameter of more than 10.
A vinylidenefluoride-type fluororubber swells and dissolves in both methyl ethyl ketone (15) and acetonitrile (8).

Immersion conditions ; R.T.x48 hrs
- - - - - - (outside) : volume increase of less than 20%
- - - - - - (inside) : volume increase of more than 20% but less than 100%
——— (inside) : volume increase of more than 100%
● : polymer soluble

●Heat resistance

Typical thermogravimetric curves

Thermal-decomposition temperature
(TGA, Heating rate 5°C/min)



AFLAS provides excellent thermal stability. The copolymer starts to decompose in open-air or in nitrogen gas only at above 400°C.
The composition ratio of the copolymer is C2F4/C3H6=55/45. This is the reason why AFLAS is very stable against heat.