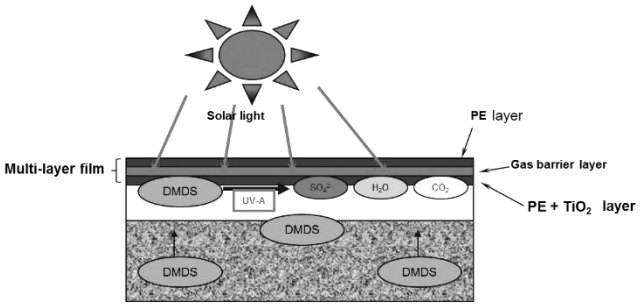
NEW PHOTOCATALYTIC TOTALLY IMPERMEABLE FILM (P-TIF) TO REDUCE FIELD FUMIGANT RELEASE

T. Aubert*, T.Fouillet and P.Charles, ARKEMA France, Groupement de Recherches de Lacq

M. Le Bechec, N.Costarramone, S.Lacombe and T.Pigot, IPREM UMR CNRS5254 Université de Pau et des Pays de l'Adour



Paladin® (Active substance = Dimethyl Disulfide or DMDS) was registered in 2010 by the United States Environmental Protection Agency (EPA) as a restricted use pesticide to be used only by Certified Applicators. Its efficacy as a pre-plant **soil fumigant** for the control or suppression of weeds, soil-borne plant pathogens and nematodes in soils has been extensively demonstrated and its use is growing as a replacement product for other less efficient or more toxic fumigants.

DMDS has an objectionable odor and low odor threshold. In order to manage emissions and therefore odors from treated fields, **Paladin®** must be applied in combination with an EVOH based barrier film, or "Totally Impermeable Film" (TIF). The use of TIF also allows a substantial reduction of application rates while retaining efficacy.

Arkema has recently developed a new TIF tarp with added functionality: a Photocatalytic Totally Impermeable Film (P-TIF) for soil fumigation. This film is based on the photocatalytic behavior of a mixture of anatase- and rutile-phase TiO2. P-TIF is able to significantly reduce planting interval, while controlling emissions and odor. The mechanism involves the rapid decomposition of fumigant under the tarp by OH. radicals created by the reaction of water catalyzed by sunlight UV-A with TiO2 particles. These highly reactive radicals react with Dimethyl Disulfide (DMDS) thanks to the incorporation of TiO2 into a

polyethylene layer which is quite permeable to DMDS and to a good dispersion of TiO2 into the polyethylene layer. The sulfates formed by oxidation of DMDS are eliminated from the film thanks to the high humidity conditions under the film and represent an additional sulfur source for the soils.

During this presentation, we will present laboratory studies and field test that demonstrate the photocatalytic activity of the embedded TiO2 layer and its efficacy in terms of reduction of DMDS in the atmosphere:

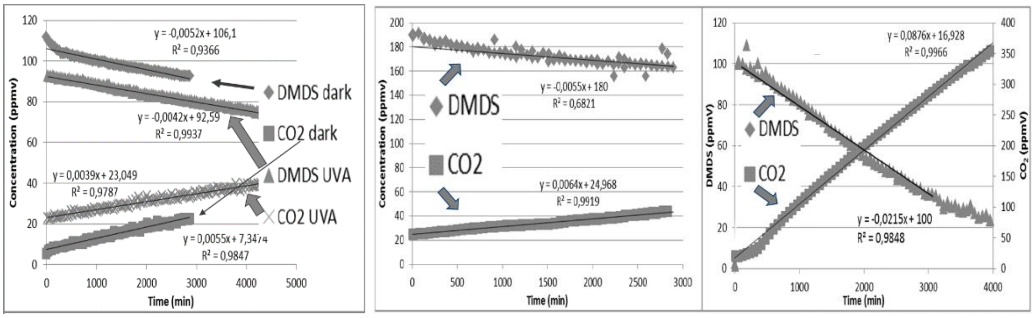
Laboratory photocatalytic tests were performed by IPREM (Univ. of Pau, FR), using a 144 l closed chamber filled with 100 ppmv of DMDS and equipped with an upper pyrex window; above the window were placed 4 UV-A lamps delivering 4 mW.cm-2 UV-A (open-field conditions) or 0.7 mW.cm-2 UV-A (greenhouses conditions); below the window (in the closed chamber) were fixed the different films.

Recording the decrease of DMDS concentration and increase of CO2 during 60 h allowed the determination of the kinetics of the photodecomposition of DMDS and, by comparison with films without TiO2 and under dark conditions, prove the photocatalytic activity of the TiO2 layer:

Reference film = EVOH based fumigation film (« TIF », no TiO2): with and without UV

3% TiO2 P25 (P-TIF) : without UV

with UV



Rates of DMDS decrease :	4-5 .10^{-3}	5 .10^{-3}	**21**. 10^{-3} ppmv min^{-1}

In addition, a field test carried out in Italy (by CERSAA, Albenga) showed the efficacy of the new P-TIF in terms of reduction of odor: after 2 weeks of fumigation by 600 l/ha of Paladin®EC through a drip irrigation system, the odor intensity during film removal was assessed by well-trained personnel: on a scale from 0 to 10, the result was 0 for our Photocatalytic-Totally Impermeable Film and 3 for a non-photocatalytic Totally Impermeable Film.

As a conclusion, the efficacy of the new Photocatalytic Totally Impermeable Film developed by Arkema was demonstrated; this film is manufactured by a standard extrusion process and is now available at the industrial scale. It should provide the farmers with a new tool to reduce the planting interval, the buffer zones and the odor problems and finally to increase their safety and their productivity.