

Asia Pacific Coatings Congress

The Increasing Effect of UV / IR on Grey Roof Coatings

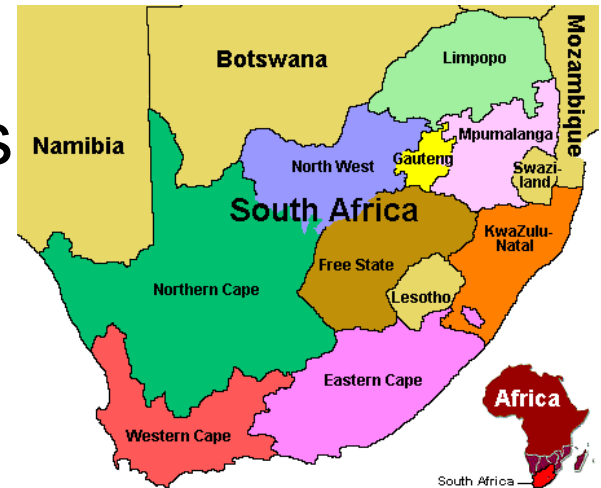
Philip Green- September 5th 2019

Who Am I?

- **Name:** Philip Green
- **Company:** Mirmac Paint + Research
- **Function:** Paint Technology Consultancy
- **Areas of Focus:** Formulation, Production. Training and Problem solving for Paint Companies in Developing Paint Markets
- **Number of Years involved in Paint:** 37
- **Number of Years as a Consultant:** 21

Background 1

- In Southern Africa as in many developing paint markets Water Based Roof Coatings are, and have always been extremely popular
- In the 1980's most paint companies made a limited range of colours, the most popular being Red Oxide, Burgundy, Green and Black, with some companies Offering Greys but neither them nor Black was that popular.



Background 2

- In my first 10 years in the paint industry the only problems I came across for roof coatings were poor adhesion, Flaking/ Peeling issues- and they could be traced to poor surface preparation / short cuts taken by the applicators



Background 3

- Then in the early 1990's some of the larger paint companies started offering roof paints in deep/ bright colours like Royal Blue and Bright Green and due to the High UV in Southern Africa these Colours Faded/ Chalked quite quickly (2-3 Years) and eventually they were withdrawn much to most paint chemist's relief.



Acid Rain 1

- Then in mid-late 1990's we started to see a range of oxide based earth colours (Red Oxide, Burgundy, Chrome Oxide Green and Greys) become lighter in colour within 6-12 months but not in all areas but in specific locations, it was also not limited to one companies roof coatings but more to Location.



Acid Rain 2

- My consultancy was involved in thoroughly investigating the issue and after a lot of work we traced the cause to acidic rain coming from 3 sources:
 - Coal fired power stations
 - Oil refineries/ other industries
 - Burning off of crops at the end of the growing season
- All give rise to acidic air borne pollution that gets carried by wind and rain and then the acids attack the calcium carbonate in the roof coating causing the lightening effect



Acid Rain 3

- We then investigated which extenders / combination of extenders could be used as a cost and property effective way to minimize the effects of acid rain in roof coatings, without affecting long term durability
- In RSA this was generally a Feldspar or Feldspar in combination with Talc or Mica but in other countries Baraytes and Kaolin were also used



Move to Greys

- Between 2012-2015 after the positive effects of the 2010 World cup wore off the adverse economic effects the 2008 “economic crash” and the political climate hit Southern Africa hard and there was a definite move to more neutral colours on buildings that blended in and were long term durable. This was for roof, wall and trim coatings and it mostly manifested itself in many shades of grey varying from pastel through medium to very dark grey, almost black (Charcoal). Not only that but long term performance became the norm every body wanted a 10, 12 or 15 year warranties the terms of which were often not understood by either the asset owner or the applicators/ painting contractors



Failures Begin to Occur

- In 2015- 2016 we started to hear of roof coatings that started to prematurely fail and not just on site applied roofs but also factory applied water based roof tile coatings
- Again the problems were not limited to one paint producer or region but were from many producers and on analyzing the data there was only one common factor- they were all greys- with medium and dark greys showing the most issues
- For one company grey/ charcoal/ black roof coatings were 15-20% of their roof coating sales and 80% of their claims

Example 1



Example 2



Example 3



Example 4



On Completion

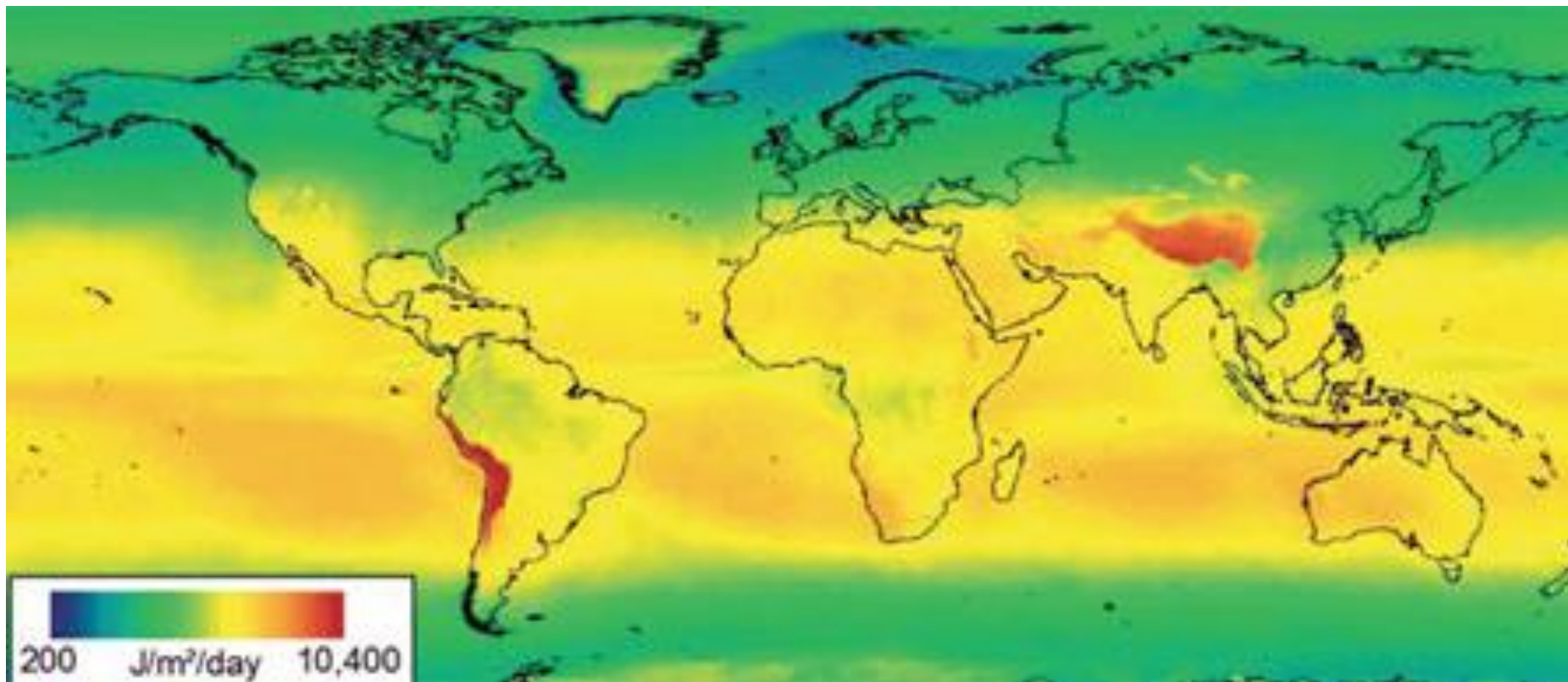


After 18months

The UV Angle 1

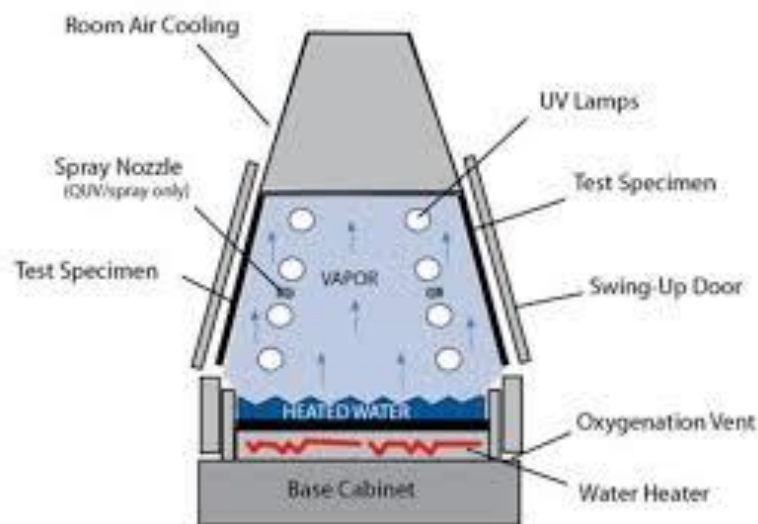
- At first we thought it was a repeat of the 1990's acid rain attack scenario but then we began to see that all the problem sites had used paints containing Feldspar and or other acid rain inert fillers and it only seem to affect grey/ black not other colours in the same locations
- And in quite a few cases the coating itself had started to chalk which pointed to a UV attack of the polymer type problem

The UV Angle 2



The UV Angle 3

- We then applied wet paint samples from many of the problem sites, on to panels and put them on exposure in a QUV and/ or a Xenon Accelerated Weather Chamber even after 2000 hours of exposure in the Xenon/ QUV we could not reproduce what we were seeing in the field



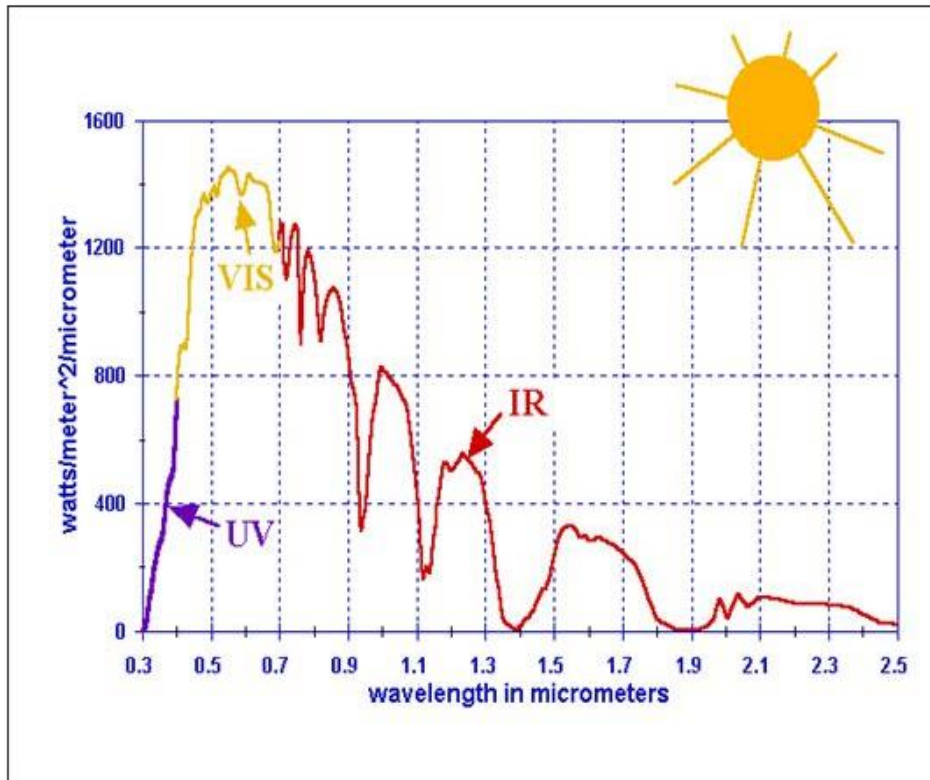
The UV Angle 4

- Someone suggested that the normal temperature (50-60°C) used in an accelerated weathering chamber (QUV or Xenon) was not quite high enough to reproduce the temperatures experienced on a roof so we set the black plate metal temperature to 80°C and ran the QUV cabinet for 1 000 hours again we could not reproduce the problem but we burnt out the sensor- so we abandoned that avenue



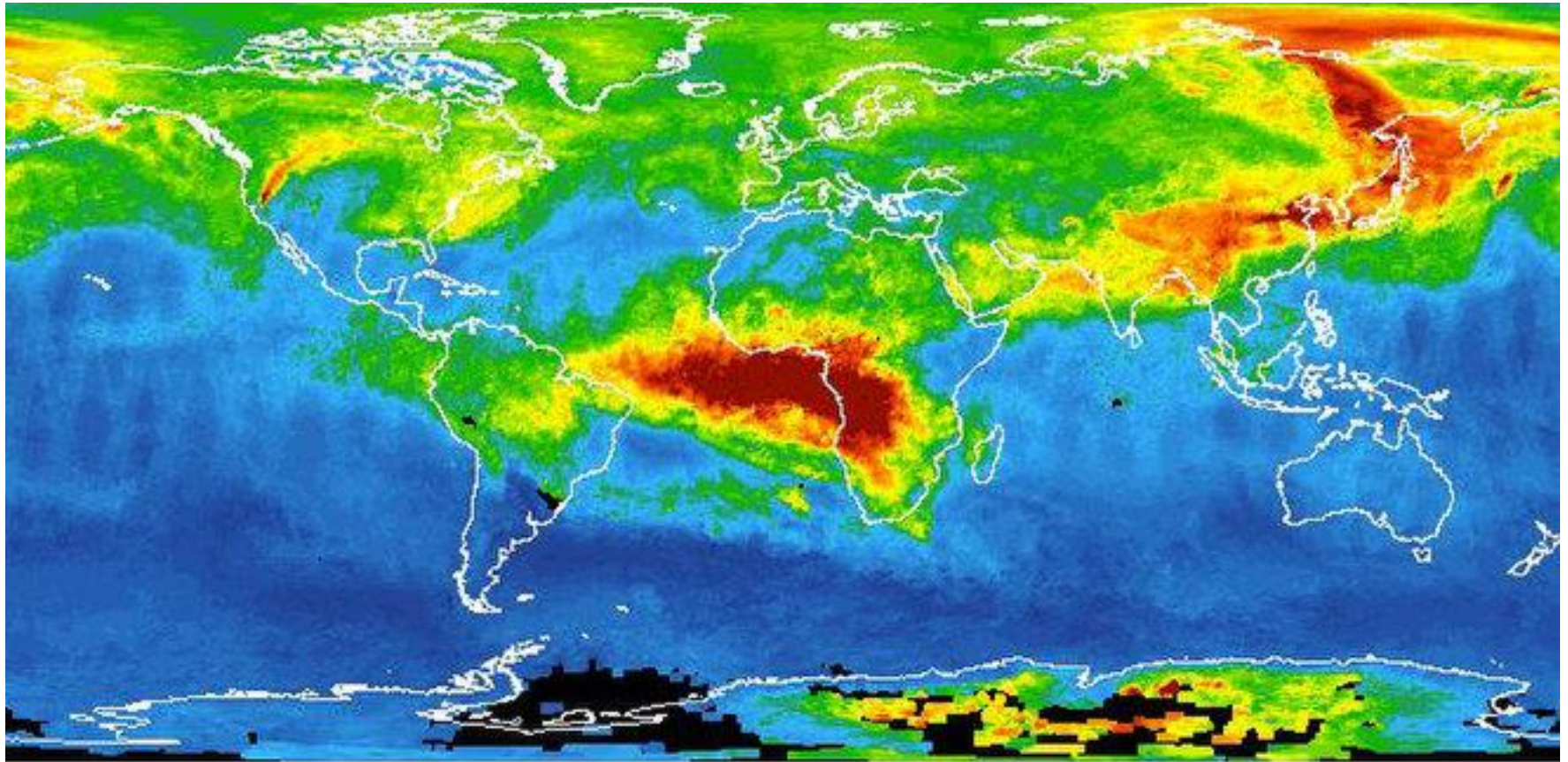
IR Angle 1

Solar Energy Spectrum



- Ultraviolet (UV)
 - 3% of total energy
 - responsible for sunburn
- Visible (VIS)
 - 40% of total energy
 - visible light
- Infrared (IR)
 - 57% of total energy
 - felt as heat!

IR Angle 2



IR Angle 3

- It can be seen from the above slides that IR as heat could have a huge effect on roof and wall coatings so we carried out a series of experiments where we heated up metal panels painted with various grey / black coatings (roof / wall) and monitored their colour spectrums and film condition even after 2-3 weeks at 95-100°C most coatings showed no dramatic changes although some alkyd based turned yellow faster and started to crack as their cross linking mechanisms were accelerated but none of the water based products showed any of the issues that we had seen in the field.

IR Angle 4



UV / IR Combined 1

- We then started to look at cycling between heat and QUV- we started with 4 days in an oven at 120°C and 3 days in the QUV- normal cycle.
- Then we started to reproduce what we had seen in the field mostly after 5- 6 cycles or longer but for some polymers that had not shown any issues in the QUV / Xenon started to show issues after only 2-3 cycles

UV / IR Combined 2



UV / IR Combined 3

- So now we have a tool to be able to quickly test whether a change to the system brings a benefit or not
- So far we have seen that:
 - Texture initially makes the colour change less visible but as the break down accelerates the texture makes the break down more visible

UR / IR Combined 4

- Initially every body felt that Iron Oxide Black should be a better option than Carbon Black Pastes but from our work there is no real difference.
- Both are IR absorbers and both give the same issues if the latex polymer used has a tendency to breakdown under heat (IR) and UV

UV / IR Combined 5

- Some Latex / Emulsion suppliers suggested that the fillers used in the roof coating can effect the performance as some of them are IR absorbers / insulators (e.g. Feldspar)
- From our work to date it only helps slightly if the emulsion used is prone to breakdown due to the UV / IR combination it does not really help to change the extender especially as the change may lead to other issues like acid rain attack occurring

UV / IR Combined 6

- We have begun to test IR Reflective Black Pigments from the 3 main suppliers and the results are interesting and from what we see polymer seems to be more important than the actual pigments for some polymers, although the use of IR Reflective Black Pigments always helps it is more effective when the polymer is less sensitive to the UV / IR combination

UV / IR Combined 7

- We are also seeing that both film build and on re-painting roofs what the original colour on the roof was- if it was black / dark grey it has to be isolated from the new top IR Reflective Black Pigment containing roof coat by coats of a white roof paint before repainting.



UV / IR Combined 8

- We are also looking at other IR and UV reflecting technologies such as Venator's Altiris and other Nano sized material technologies

Conclusion

- Hopefully I have clearly described the problem and given you an accelerated test method to identify if the problem is occurring and what maybe the route causes and solutions
- Please feel free to ask me any questions.

Thank You