Analysis of the Car Bodywork Protective Coating's Destruction in Contact with Marine Bird Droppings on the Black Sea Coast

Laurentiu Claudiu Manea, Adriana Teodora Manea, and Camil Tudor

University „Ovidius" of Constanța, Romania

profmanea@yahoo.com

Abstract. In the paper we take in considerations some possibilities of identify, based on a "template or pattern visually determined" the car bodywork protective coating's destruction in contact with marine bird droppings on coast zone - referring directly to a specific panel of a premium body frame manufacturer – where, through experimentally searching reporting referential and systematic precision measurements of coating thickness in the affected area, we shape the deformation of the coating and simulated it in a virtual environment, highlighting possible causes of the loss of the aesthetic qualities protection of the car-body-frame film layer.

Keywords: automotive body coating, visual pattern effect, bird droppings.

1 Introduction

This research is the subject of a Court case in which the owner request replacement of his new vehicle during warranty period, because of changing of its premium range car aesthetics outer coating body frame panel left rear wing-. Technical expertise had to determine either the destruction was due to alleged causes generated by the production process of the manufacturer, or there were prerequisites for a destructions caused by external factors – in case - those which appear in contact with the droppings of seabirds in the marine coast area -. Finally we find a similarity with a recognized destruction pattern, already noticed by the specialists, for this type of the external factors impact over the protective coating film of the car frame.

2 Experimental measurement and simulation in virtual environment of the coating of body parts in question

Visual analysis carried out on the state of body coverage (with multiple layers which include color pigment layer - and final transparent protective layer -) shows that in the

area of interest investigated in the aesthetic destruction signaled was made a strong polishing action with a rotary device, without the removal of the reported deficiency (Figure 2 a, 3).

Taking a set of measurements in the area of interest, after statistical and mathematical experimental data processing we can see that there are two types of mechanical stress applications of the coating framework panel "*left-wing rear-area B*: points 13,14, 15, 16, 25 are in a "depression" relative to points 8,10,19, on the same level with 19, as the area around the depression as "up" over a toughest element of stability that would be at the center of it. (*Areas colored dark red to indicate this izo-height curve located at the points 17, 18, 9*), the differences being (on average order) of 5-7 microns Because the research area in question -B, *Figure 1*, turned out to be, after the measurements made between the right similar body panel, with reference to left body element from the car frame of 2016 production time (with an Aluminium and not ferrous frame) coverage area uneven lower than in areas adjacent (probably part because of technology coverage on the painting manufacturer's plant, either possible in our opinion due to the emergence unauthorized effort applied on the protective surface by strong polishing -hoping uniform the final transparent coating film surface at the site - (*fig. 2 a2,3- obvious circular destructions show in polarized light*).

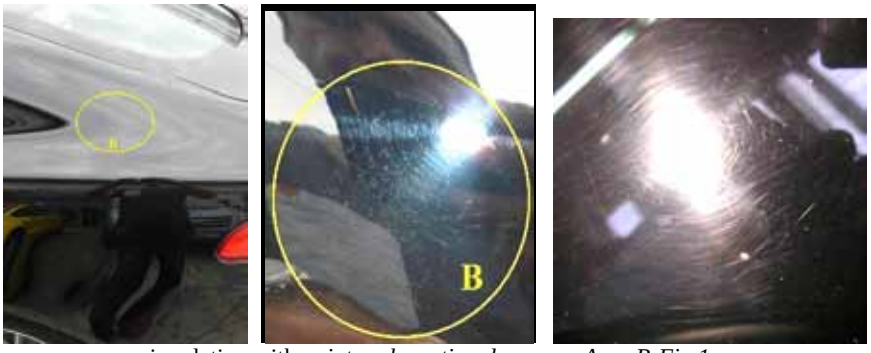
a. 2016 metrologised & quality control meter gauge used during mesurements

b. Left rear wing of the car in case, viewing on *B zone* - area under further "zoom"virtual measurements investigation

Fig. 1. Technical aspects of obtaining experimental measurements of coating thickness distribution on framepanel „rear wing" in zone B

We had to observe that the final thickness of the coating measuring of the body was within the limits stated by the manufacturer. After the panel surface of the *left rear wing* was digitized with MATLAB software we „virtually zoom in" the affected

area (*Figure 1 B*-zone, bounded by the measuring points 9,10,11,18,12,25,13,14,15,16 - corresponding to the measurement values of the coating thickness), to establish a "template or a pattern" deformation, and later, to compare it with the related assumptions and existing cases in the bibliography in order to move forward and argue a possible succession of emergence and evolution of the destruction. (*Figure 3*).



a. in relation with *paintwork coating damages; Area B-Fig.1*

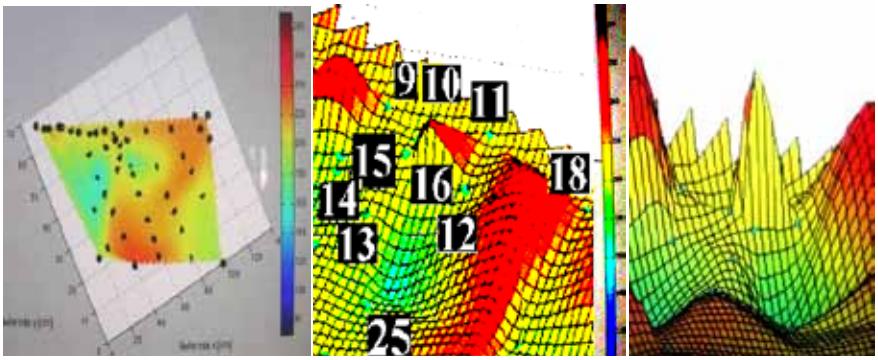
b. zoom on "spider type template" area B - under investigation

Fig. 2. Photos of the claimed aesthetic damaged area of the *left rear wing* body panel

2.1 Analysis of the experimental measurements results

Summarizing the observations, emerge the following assumptions validated by the experimental measurements:

1. The damage appeared likely in the summer time season in 2015 when there were above normal maximum elevated temperatures during the day on the Constanta Black Sea Coast (33-35 degrees C), and when the at black color body exposed to direct sunlight reached very high temperature values (60-80 degrees C) due to strong caloric radiation absorbing [6].
2. Exists on the damaged area izoheights divergent type "depression" (at 10 microns scale) generated either by a corrosive attack on the transparent coating or due to a change (within 7-10 microns) in the surface layer of the transparent and color film in still uncertain circumstances;
3. Exists on the body panel " back wing " so on the vehicle in question and also on the reference dealer's vehicle a reduction measured of the coating in the area where there was reported the damage (but currently in the technological limits indicated by the manufacturer) due probably either of the surface shape or constructive design configuration panel of body frame „rear wing" either or because of the technology painting (grain drop paint, tilt head robot painting, instantaneous pressure design particle paint cone, value of the electrostatic field created between body and "ground"), the total thick coverage remain more consistent towards the upper edge of the body "rear wing" and less in zone B, - where the present claim and research was focuses. It should be added that coating, if studied (when the coating thickness was not influenced by repair coatings, paints, and subsequent transparent coatings falls within the general engineering supported documentary producer, between 79 microns and 526 microns.



a. car left rear wing –in the case- with B -fig.1 under investigation area (visualization with virtual magnifying "zoom")
Mathematical distribution defined by the measuring points 9,10,11,18,12,25,13,14,15, 16, 25 and experimental results in terms of coating thickness analysis -inside manufacturer limits-

Fig. 3. Issues getting through virtual simulation in MatLab of the coating thickness on the frame panel „rear wing" B area

4. Since the relevant experimental data reveal that in the B area from *Figure 1* has been shown to be measurements with uneven horizons of izoheights lower than adjacent areas it is possible that this highlight the damages made by an unauthorized

polisher in his effort of clearing and uniform the coating damaged surface – fig.2,a,2,3, (evident transparent coating circular destructions –in polarized light);

5. It is likely that once damaged the paint and the varnish, either from technological or from external reasons (*through its removal by an unauthorized intervention*) to be amplified the initial destruction, whereas in the polarized light zone we can clearly observe "circular grooves" resulting from unauthorized polisher or likely improper abrasive grain based on chromium (*Figure 2,a*).

Along with recommendations (shown in Figure 4) may not respected by the owner in this regard, research has identified on the manufacturer's official website a set of recommendations related to the maintenance of the body, which in part included in the present maintenance manual of the car.

As alongside the repeated operation of polish (for protection coating of the bodywork) which had to be done only by qualified personnel, with polish cream recommended only by the dealer of the producer (without abrasive particles based on chromium) and additional textile materials agreed by the brand, the recommendations for maintenance on body surface coatings have strong indications upon "aggressive and corrosive attack of bird droppings" (Annex 1.2), given that on the Black Sea Coast there are many species of marine birds that usually random defecates we started also the search in this direction, linking it with the related observations of specialists in marine biology that claims the increased acidity content of birds excretory system (concentrating in one place called "vent" - liquid and solid manure). Studies show that marine bird droppings (which varies depending on the species, diet, season) are a cocktail composed of salts rich in nitrogen (8-16%), ammonia, ammonium oxalate, urate, uric phosphate, uric acid and phosphoric potassium (2-3%) / ammonium biological materials, including bacteria and enzymes [4] and that the oil contained in the excrement of seabirds make their adhesion to automotive paint to be big and have the effect of catalyzing attack reactions on cover frame body coating films.

A research laboratory sample of the body panel requested by the technical expert (not accepted by car owner who desire to preserve evidence for future expertise), (heated to 60-80 degrees C, in reaction with the mix of these components from sea bird droppings and then cooled to a difference of 45-60 degrees C levels, could provide useful information about behavior of the coatings layer's coverage on in these circumstances, of course respecting ISO 2812-5: 2007 *Figure 6 –coatings, varnishes - determination of resistance to liquids - part 5: temperature-gradient oven method where specified a method of determining the resistance of the coating material to the action liquid or semi-liquid*, variant simulation -with bird droppings diluted with water-pancreatic would allow the application of ISO 3696 "water analytical laboratory use - specifications and test methods" being not applicable)

Studied bird droppings in contact with the car body coatings proved harmful varnish and paints damages, fading and even in depth degradation of the bodywork coverage (*fig.2*), amplified by:

1. magnifying to time reaction (destruction can occur within a few hours of action, so it is extremely important to made a rapid removal of the deposits from the surface of the car-body). Deposits must be removed as soon as possible with a solution

agreed by the manufacturer (which is usually based on distilled water and isopropyl alcohol and other constituents in well established proportion) which must be allowed to react on the deposit more than 10 minutes on a piece of fabric agreed - as in addition to the corrosive effect there are many biological materials with severe impact on human health "*so cleaning hands is strongly advised or carried out only with special gloves protection*."

2. grain excrement and water content (as the grain deposit is bigger it becomes more rigid during the day and during the night on the cooled the body, if it is not removed, it becomes solid so the inflated transparent film of varnish and paint around shrinks around it taking the form of a cone or a "spider webs" as it is considered in the literature: "typical damage attack pattern to the car body coating with bird droppings" (see *Figure 1 versus Appendix 1*).; the water content maximizes grip and manure to activate the reaction body shell leveraging it in the early stages, until the formation of solid deposit.

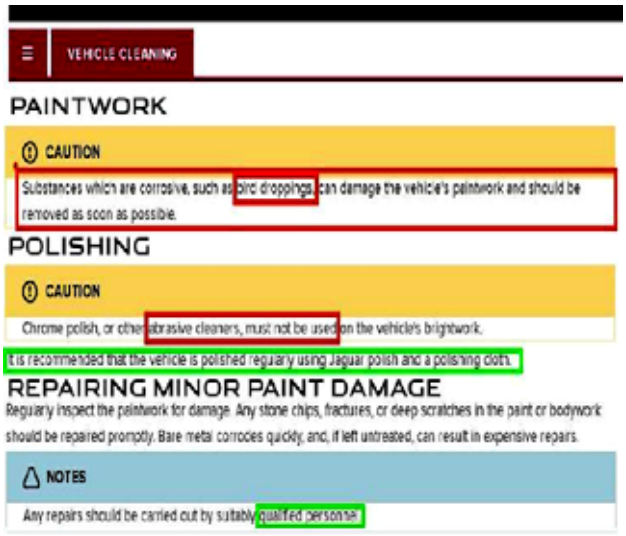


Fig. 4. Owner obligation to respect producer's rules related with the maintenance of body frame paint-coating

3. temperature of the car frame during the impact (leading to the activation of components in the coating layer dilated and attack deeper and more corrosive the varnish layer stretched on smaller inflated thickness, and dry faster and intense deposit solid. Dark colors of bodies are most exposed (black amassing maximum heat radiation) and high temperatures during hot summer days amplifies the destruction process (see *Figure 5)*;
4. high temperature variation on hot summer days versus night, with daytime maximum temperatures exceeding 30 degrees C and 16-23 degrees C during night time, cause dilation and extent of the clear coat and the paint during the day, and in the event of a deposit which rapidly solidifies contraction of different paint around the varnish and with specific destructions of the paintwork with color pigment. If the

reaction persists then cause irreversible damage to the protective layer of varnish and repainting it is necessary on the entirely body part.

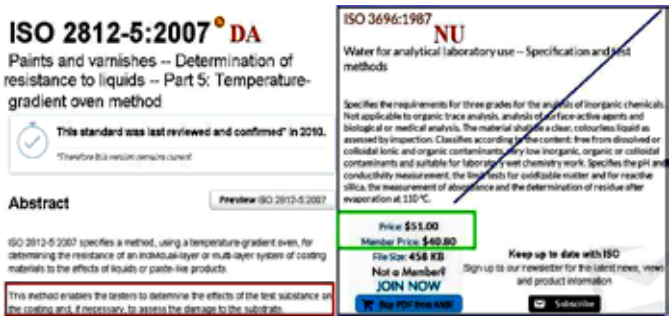


Fig. 5. Standards ISO 2812-5: 2010 to be applied in laboratory in case of an attack of various substances on multilayer coatings

Thickness of the multi surfaces coatings with producer technological limits from 79 to 526μm offers a very extensive thickness coating interval; measurements on the vehicle body in the case (also on the dealer's reference one) generally indicated that values are within the specified limits but in the interest area (zone B-Figure 1) it was proven experimentally a local decrease of the coating thickness film. We had not at our disposal a powerful laboratory device to measure the thickness of each distinctive layer deposited in that area but we presumed, from the technological specifications, that it is expected to be in the same thickness proportion over the entire body. This shows that the area B, with a proven thickness less substrate (which expands at high temperature thinning further its thickness) may be more susceptible to an attack with more persistent and more evident destructions than other areas of the car-frame.

The thickness of the body and its position in relation to the sun prior to the impact with the corrosive substance. The element body is exposed to sunlight (top left rear wing).

The related image's documentation available in the bibliography and in other video and photo documents from the Internet (*whose content vas selectively presented in Appendix 1*), show that the interaction of bird droppings over the covering film coating of a car body resulting can be compared with a form of destruction or „*a pattern - spider web type* -" as the the owner of the car in question complained on]n the court relating with its left rear wing (*Figure 2 b*) damage. In this stage we can advance the following observations:

1. Architecture (design and organization) claimed the overall destruction of "spider web" on the paintwork with color pigment under the transparent layer of lacquer is similar to those identified as "follow the dung-bird droppings -type" on its own coating layer premium car body frame.
2. We can not compare the magnitude of destruction "in deep" because no producer technical data were provided for comparison in this respect and for the car in the case is considered that the not conform polishing treatment destroy the margins of

the affected area and made irrelevant a microscopic laboratory search of the damaged coating film "in situ".

3 Conclusions

Studied bird droppings in contact with the car body coatings have been proven harmful for varnish and paints, causing fading and even degradation in depth the film coverage of the bodywork (Figure 2 versus Appendix 1) effects amplified by: maximizing the time of reaction (destruction can occur within a few hours of action, so it is extremely important to remove rapidly the deposits from the surface of the body), grain, manure and water content there of (as the grain is bigger the deposit becomes more rigid and if it not removed during the night cool of the frame, it becomes a solid around which clear coat and paint shrinks, the paint taking the form of a cone or a "spider webs" . One it consider as a "typically damage attack of bird droppings on car frame /see Figure 2) "body temperature during the impact, body color, the thickness of the coating film of the car-frame, thickness of the frame panel and its positioning in relation to the sun (prior to the impact with the corrosive substance);

We can say that in the respect of our search exist the possibility of finding a corresponding „pattern of destruction" type-like „image of spider webs " contraction of the color paint film under the protective transparent car-frame coating.

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Appendix 1 Photos of the aftermath impact of bird droppings ("Bird droppings, bird-poo") and coating surface of car bodyframe *Source: www.AutoGlyme.com*