

Viscosity Controlled High Penetration Wax on Paint Process

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ABSTRACT

The wax has been developed that is able to protect vehicle bodies from corrosion for extended periods. Vehicle bodies, composed mainly of steel components, are prone to corrosion, in particular side sills and various flanges. These sections are generally coated with wax to protect them from water, primary corrosion-promoting factor, enabling manufacturers to offer extended warranties against corrosion perforation in their catalogs. However, while corrosion prevention systems using conventional waxes contribute significantly to increased corrosion prevention, they result in increased costs, for example for dedicated wax coating lines in production lines, and require specialized lines tailored to specific vehicle bodies. Areas such as side sills and various flanges require careful attention to, and particularly high standards of, corrosion prevention. Particular attention to coating required in these areas tends to increase volume of coating material employed.

Wax developed in this project displays excellent penetration. Material is able to penetrate into flanges, enabling achievement of a high level of anti-corrosion performance using a reduced amount of wax. This wax is controlling the viscosity characteristic of material, and is not accompanied by change of the conventional paint process. Moreover, it could permeate in a little coverage, and an opposite flow-out is prevented and wax with a high rustproof function was developed.

INTRODUCTION

The water from road surfaces infiltrates vehicle bodies as they are driven. There are many points on a vehicle body in which this water can collect, and in order to help

ensure corrosion resistance, it is necessary to sufficiently degrease vehicle surface, employ chemical pretreatments, and apply an e-coat.

In addition to structure of vehicle body, salt contained in infiltrating water is another factor in occurrence of corrosion. Today, an increasing amount of chemical agents are spread on road surfaces in winter to prevent them from freezing⁽¹⁾, making road environment increasingly severe in terms of corrosion.

Canada Code (1.5 years free from exterior corrosion and 5 years free from corrosion perforation) was formulated in 1976 to protect consumers. In 2000, Northern European consumer advocate groups formulated a more stringent set of conditions (5 years free from exterior corrosion and 10 years free from corrosion perforation)^{(2),(3)}, and there are an increasing number of cases in which warranty period for corrosion perforation of vehicle body is set at 12 years in European market.

Anti-corrosion waxes shield vehicle from oxygen, water, electrolytes and other corrosion-inducing factors, and are able to control corrosion in flanges, where corrosion resistance cannot be guaranteed by coatings. Automakers employ a variety of different methods to apply wax to vehicle body following e-coating, including continuous flow nozzles, mist sprays, and immersion of the lower section of the body⁽⁴⁾. In the 1970s, when the automotive industry commenced its battle against corrosion, anti-corrosion wax first made its appearance in liquid form as a Vaseline-like agent dissolved in a solvent. Waxes took their present form, a thin film able to effectively prevent corrosion, in the 1980s. Waxes are easy to use and increase corrosion resistance by penetrating into the interior of complex body shapes, but

issues remain in terms of ensuring corrosion prevention in flanges and certain other areas. The research focused on in this paper therefore attempted to develop a wax with stable anti-corrosion properties that would effectively penetrate flanges, which function as points of origin for corrosion. This paper will discuss the results achieved.

DEVELOPMENT CONCEPT

The application of a warranty period of 12 years against perforation corrosion necessitates the development of a method of preventing corrosion in the weak points of vehicle body, in particular the side sills and rear wheel arches.

Flanges are the points of origin of corrosion. Chemical treatments and e-coats and other coatings cannot sufficiently corrosion-proof flanges, and the corrosion that originates in them eventually develops into perforations. Filling flanges with anti-corrosion wax is one effective method of preventing this from occurring. However, the results of studies of more effective coating methods and of methods of achieving the maximum anti-corrosion effect using the minimum materials have indicated that when coating flanges with wax and introducing wax to the interior of flanges, it is not simply coating flanges but achieving penetration of wax into the minute gaps that functions to protect the area from corrosion-inducing factors. In addition, this project presupposed that future waxes would not use solvents as a measure to protect the environment. However, if the solvent is simply removed from a wax, the viscosity of wax will increase, resulting in a decline in its level of penetration into flanges. Viscosity is a significant determinant of the level of penetration of a wax.

However, if a low-viscosity wax is employed to enable good penetration, wax will tend to flow from the lower section of vehicle and accumulate on the floor of the assembly line, etc., affecting work conditions and safety in the workplace. This project therefore set out to develop a wax that would display high viscosity during application and when vehicle exited the oven to be taken to the next process, and which could be reduced in viscosity by heating alone in order to achieve wax penetration. Taking into consideration the prevention of wax flow following coating, the project developed a system that exploits the differences in the temperature of vehicle body at each stage of the production process, as shown in Figure 1. The following properties were required of the developed wax:

- Penetration into flanges
- Enabling simple viscosity control by means of temperature
- No accumulation of wax on the line
- Formation of a stable film

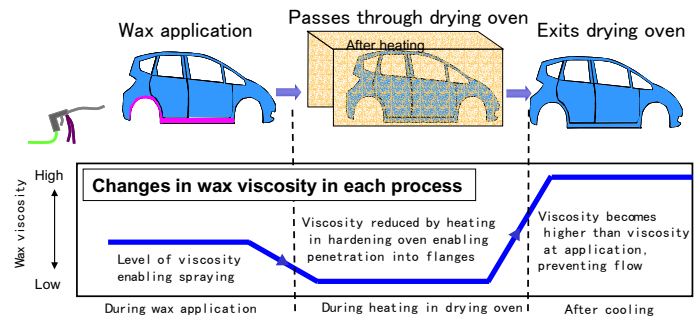


Figure 1 Layout of car coating line and concept of wax viscosity

BASIC DESIGN OF WAX

Conventional waxes use organic solvents (mineral spirits, etc.) as diluent solvents in order to achieve low viscosity. Waxes are applied in a spray form, which volatilizes the solvent, increasing viscosity and promoting film formation. Consideration was given to the removal of the organic solvents as an environmental measure, and research was conducted on the possibility of replacing the organic solvents added to reduce viscosity with a low-volatility, high-viscosity oil, leading to the development of a high-fluidity wax that was easier to apply and covered a greater area on application. Due to the high fluidity of wax, additives such as thixotropic agents or hardeners were added to wax developed in the present project to prevent flow following coating. Table 1 shows the composition of wax developed in the project discussed here. Figure 2 shows the composition of a conventional wax, the high-penetration non-solvent wax discussed above (the prototype of the developed wax), and the developed wax. The high-penetration non-solvent wax represented the commencement of the present project, which removed the organic solvents and employed liquid paraffin to reduce viscosity.

The high-penetration non-solvent waxes tended to flow from the body after application, and wax films could not be retained under the flow of water from the showers employed in the inspection procedure on the body assembly line. The fact that wax was removed in this way by physical force indicated issues in terms of film formation. This issue was addressed in the developed wax through the addition of fillers, a low viscosity hardening agent and viscosity controlling additives.

Table 1 Components of developed wax

Function	Main composition
Formation of membrane	Sulfanilic acid salts
	Petrolatums
	Petroleum wax
Additive for thixotropy	Thixotropy additives
Hardening agent	Vegetable oil
Rust prevention additive	Metallic salt oxide wax
Filler	Calcium carbonate etc.,
Solvent	Low-viscosity paraffin
	Vegetable oil

Figure 3 shows the concept of viscosity control in the high-penetration non-solvent wax and the developed wax. It shows the processes in which the applied wax flows from vehicle body, and the viscosity range of wax at these times. It was considered that the flow could be prevented by controlling the viscosity of wax in each process. It was not possible to respond to the issue of removal of the high-penetration non-solvent wax during the inspection process, but the addition of a heat-activated thixotropic agent to the developed wax enabled wax to display high viscosity by the showers used during application and low viscosity upon heating, and to achieve a higher level of viscosity following cooling. This has given wax strong retention performance and controlled wax flow. The fact that the developed wax penetrates flanges has been demonstrated by dismantling inspections. In addition, existing drying ovens can be used to wrap dry, and the developed wax therefore does not necessitate further facility investments.

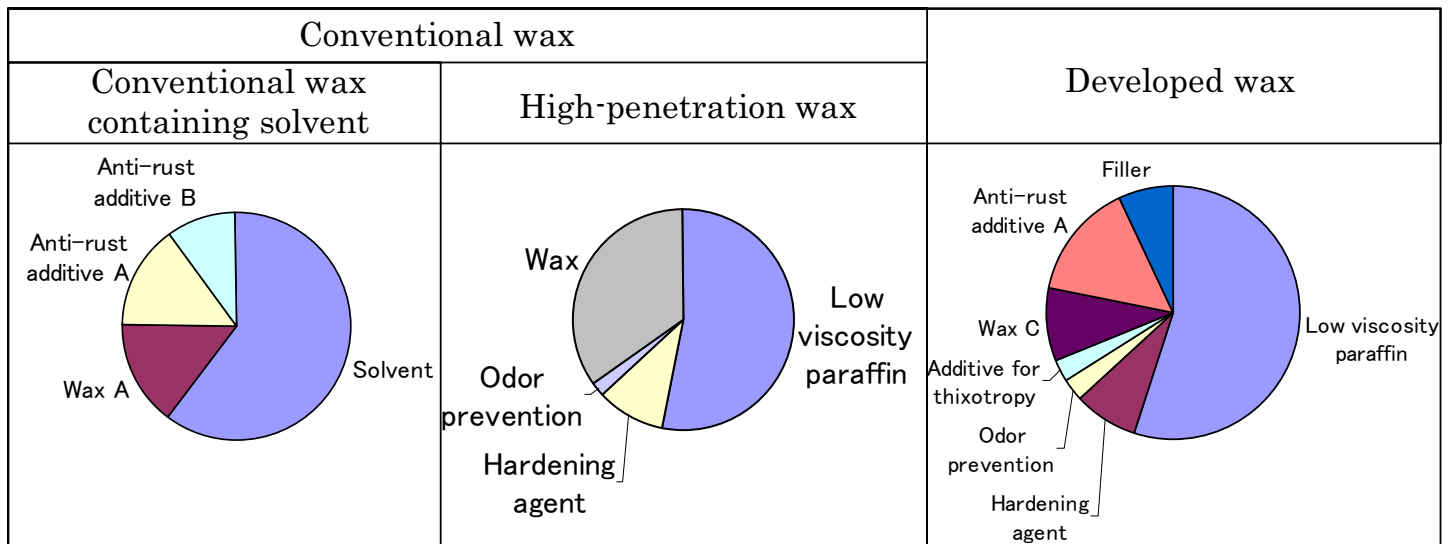


Figure 2 Composition of conventional and developed wax

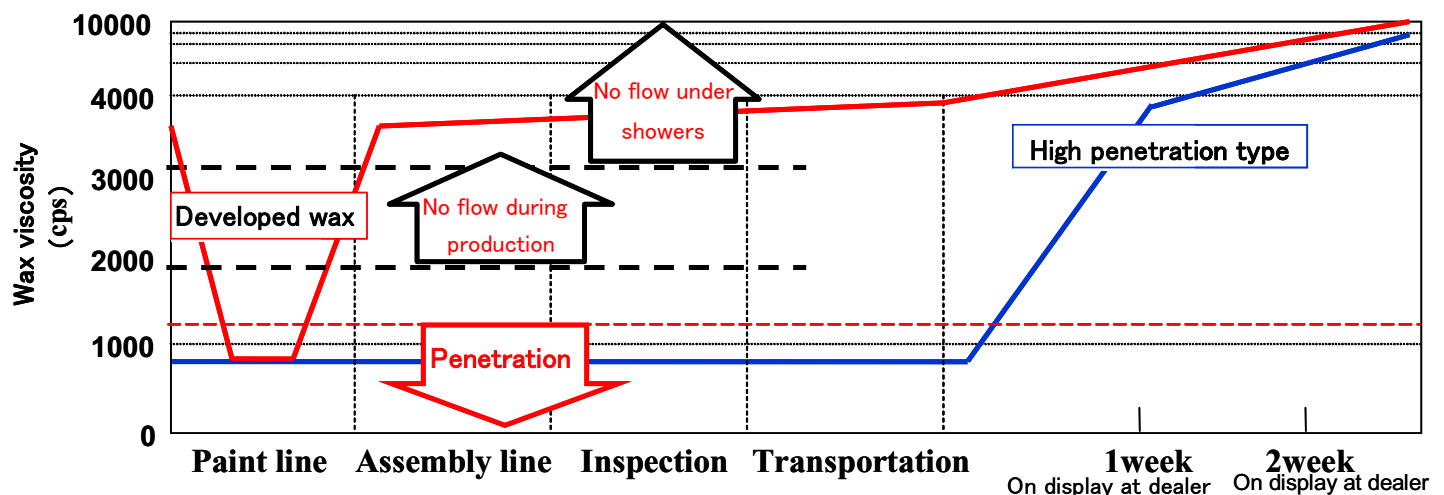


Figure 3 Comparison of behavior of viscosity of high-penetration wax and developed wax during vehicle production process