Evaluation of a Novel, PEG-free, Immediate Release Opadry® Aqueous Moisture Barrier Film Coating with High Productivity

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Purpose

High productivity immediate release (IR) film coatings with exceptional moisture barrier functionality, and no adverse impact on drug release, are increasingly preferred. The aim of this study was to characterize the properties of a novel, polyethylene glycol (PEG)-free, fully formulated immediate release, moisture barrier film coating system.

Methods

The properties and performance of a novel IR film coating system (Opadry® amb II) was compared to three commercially available PVA-based systems, Opadry® II, Opadry® 200, and Opadry® amb (Colorcon Inc., USA).

Moisture Barrier Performance

The water vapor transmission rate (WVTR) through free films with a thickness of 100 ± 10µm and a surface area of 5cm^2 was measured using a PermaTran-W 1/50 (Mocon Inc., USA) at 25°C with a permeant side relative humidity of 85%RH and a dry side of 4 - 6%RH. In addition, moisture isotherms of the films were measured at 25°C and 0 to 90%RH in 10%RH increments using a Dynamic Vapor Sorption instrument (DVS Intrinsic, Surface Measurement Systems Ltd., USA).

Dispersion Viscosity

Dispersion viscosity was measured for all systems at 20% solids and 25°C using a DV-PRO II+ viscometer at 10 rpm (Brookfield Engineering Laboratories Inc., USA).

Coating Performance Evaluation

The film coating formulations were coated at 20% w/w solids onto 15 kg of placebo tablets (10 mm, round, biconvex) in a fully perforated 24" side-vented pan (Labcoat IIX, O'Hara Technologies Inc., Canada) fitted with two spray guns. Tablets were coated using the spray rates shown in Table 1 which represent the maximum spray rate where tablet-to-pan or tablet-to-tablet sticking was not observed. The inlet air temperature was also adjusted to maintain a bed temperature of 45°C, while all other parameters were kept constant. The airflow, pan differential pressure, pan speed, gun to bed distance, atomization and pattern air pressures were maintained at 450 m^3/hr, 14 rpm, 11.4 cm, 1.7 bar and 1.7 bar, respectively.

Table 1. Coating Process Parameters

Formulation	Novel IR system	Opadry II	Opadry 200	Opadry amb
Inlet Air Temp (°C)	64	65	65	60
Spray Rate (g/min)	60	60	50	30

Tablet gloss was measured using a Surface Analysis System (Model 805A, Tricor Systems Inc., USA).

Determination of Formic Acid and Formaldehyde Levels

Formic acid and formaldehyde levels in the novel and a PEG-containing coating system were evaluated following six months storage in standard Colorcon packaging (polyethylene liner within a cardboard box) at 30°C/65%RH and 40°C/75%RH using previously described methods.[1,2]

Coated Ibuprofen Stability

Ibuprofen tablets (200 mg, 9.53 mm round tablets, LNK International Inc.) were coated with the novel film coating system (Opadry amb II) to a 4% weight gain using the parameters described in Table 1. Dissolution testing of the coated and uncoated ibuprofen tablets, packaged in induction sealed HDPE bottles, was conducted in accordance with USP guidelines following six months storage at 40°C/75%RH. Testing was conducted in 900mL of pH 7.2 phosphate buffer solution using USP Apparatus II operating at 50 rpm.[3] Samples were taken at 5, 10, 15, 20, and 30 minutes with a Varian VK7000 dissolution tester (Varian, USA). Dissolved drug concentrations were determined by UV absorbance spectroscopy at 221nm.

Results and Discussion

Moisture Barrier Performance

The water vapor transmission rates of Opadry II, Opadry 200, Opadry amb, and the novel IR film coating system are shown in Figure 1. The novel IR film coating system had the lowest WVTR value, which indicates that it offers the best moisture barrier performance. DVS analysis indicates that it also had lower moisture uptake values than any of the other systems investigated and was significantly lower than those containing PEG, as shown in Figure 2. It has previously been shown that lower moisture uptake values can lead to better moisture barriers.[4] Low moisture uptake levels, especially at high relative humidity, confirm the exceptional moisture barrier performance of the novel IR film coating system.

Figure 1. Water Vapor Transmission Rate of Free Films Measured at 25°C and 85%RH

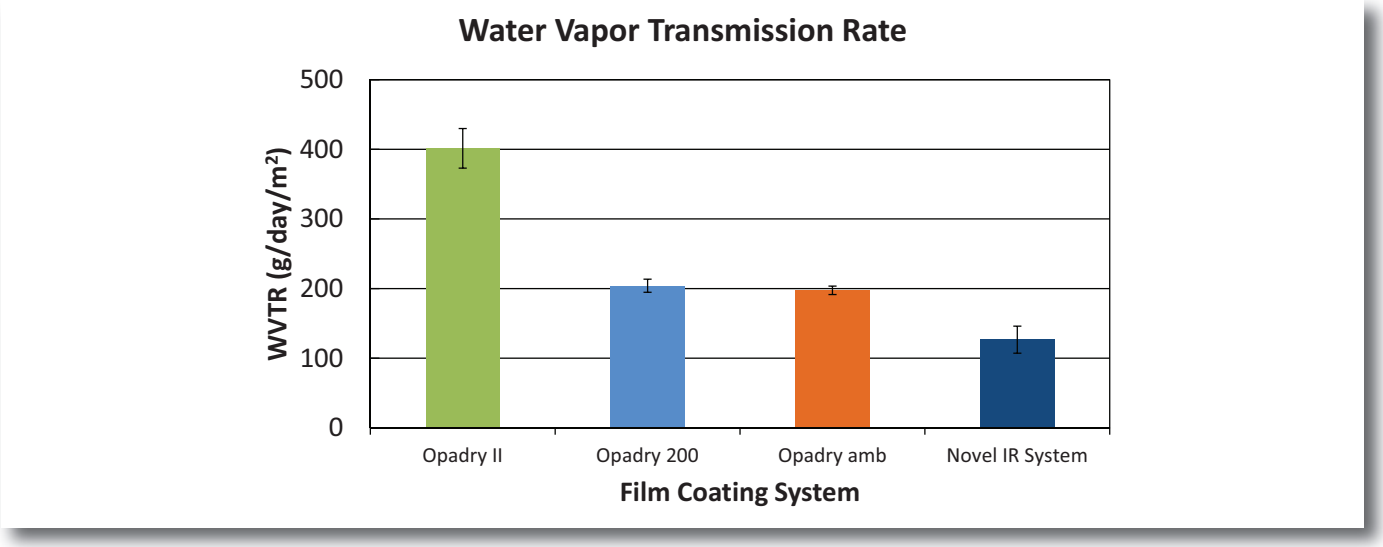
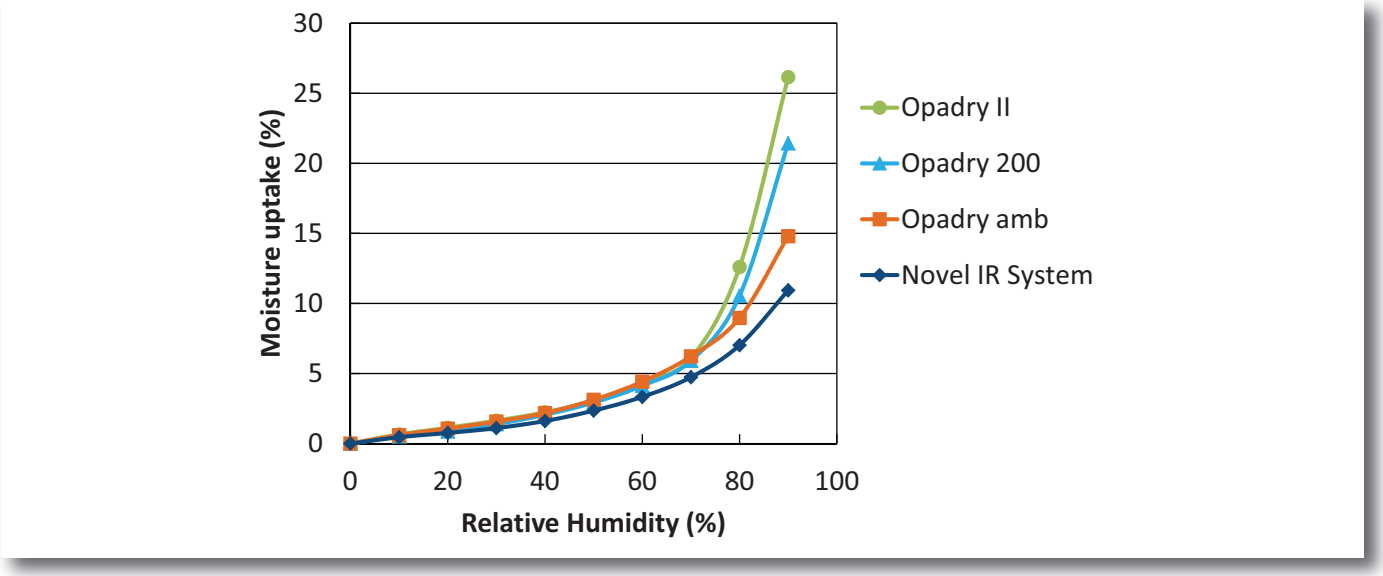


Figure 2. Moisture Sorption Isotherms of Free Films Measured at 25°C between 0 – 90%RH



Dispersion Viscosity

The viscosity of all the coating dispersions were measured and found to be less than 500 cP, and therefore suitable for spraying under normal coating conditions. At 20% w/w solids Opadry amb, Opadry II, Opadry 200 and the novel IR system had viscosities of 490 cP, 126 cP, 112 cP and 101 cP respectively.

Coating Performance

The spray rate of Opadry amb was limited to 30 g/min due to tablet sticking during the coating process. Opadry II, Opadry 200 and the novel IR film coating system offer enhanced coating productivity as seen in Table 1 due to the more effective detackifiers used in these systems, which enable higher spray rates and shorter coating times. The novel IR system also offers a reduced allergen and degradant profile as it does not contain materials such as soy lecithin or PEG. Common impurities associated with PEG are formic acid and formaldehyde, and the levels of these species found in the novel IR system and a PEG-containing film coating system are shown in Table 2. The PEG containing system showed significantly increased formic acid levels over six months storage at both 30°C/65%RH and 40°C/75%RH, while the levels in the novel IR system remain unchanged.

Table 2. Degradant Profile of the Novel IR System and PEG-Containing System

Formic Acid Six Month Results (ppm)		
Storage condition	Novel IR System	PEG-Containing System
Initial	28	21
30°C/65%RH	22	62
40°C/75%RH	25	72
Formaldehyde Six Month Results (ppm)		
Storage condition	Novel IR System	PEG-Containing Sytem
Initial	7	5
30°C/65%RH	<5	10
40°C/75%RH	<5	7

The tablets coated with the novel IR system had higher gloss values than the other systems investigated and had an elegant tablet appearance with exceptional logo definition, which can be seen in Figures 3 and 4, respectively.

Figure 3. Gloss of Placebo Tablet Coated on 24" Scale

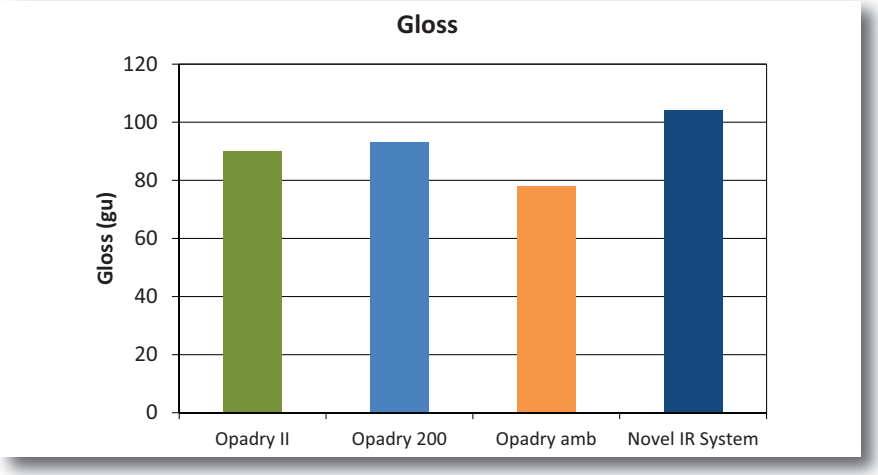
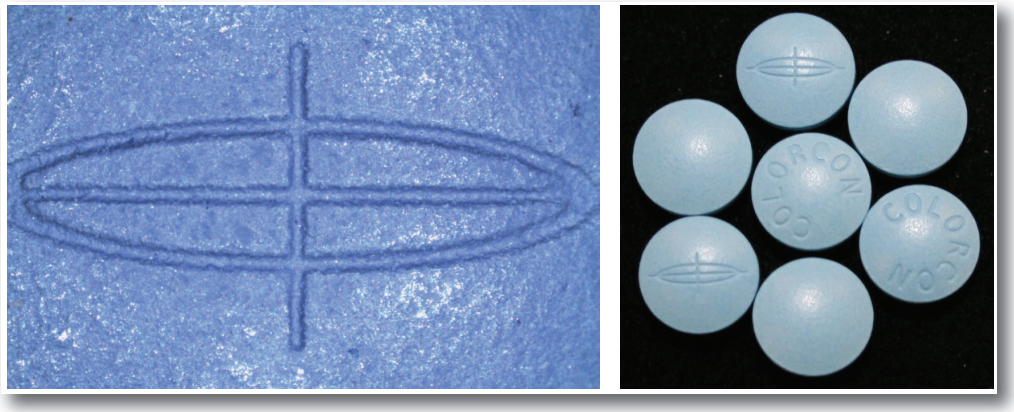


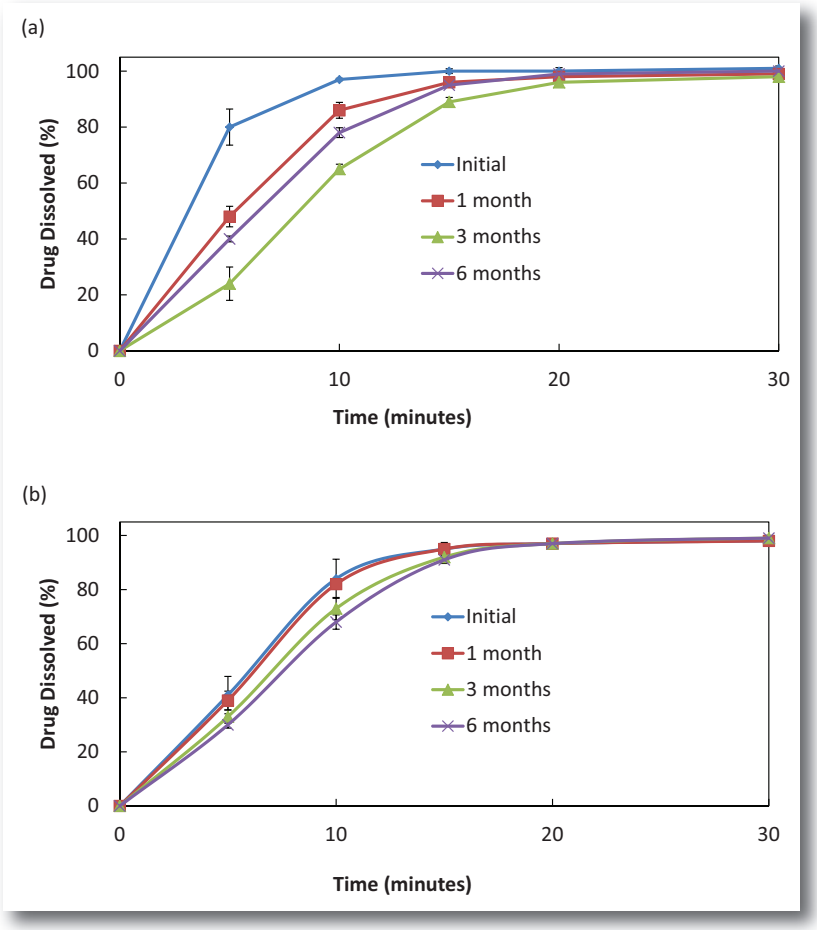
Figure 4. Placebo Tablets Coated with the Novel IR System at 4% WG



Coated Ibuprofen Stability

The dissolution profiles of coated and uncoated ibuprofen tablets following storage through six months at 40˚C/75%RH are shown in Figure 5. The release profile of the uncoated core significantly slowed during storage. In contrast, the ibuprofen tablets coated to a 4% WG with the novel IR film coating system show a significantly less slow down over the course of the study.

Figure 5. Dissolution Profiles of (a) Uncoated and (b) Coated Ibuprofen Tablets (n=6) through Six Months Storage at 40˚C/75%RH.



Conclusions

A novel PEG-free IR film coating system, Opadry amb II, that exhibits excellent moisture barrier performance, high coating productivity and low impurity levels has been described. Tablets coated with the novel IR system have an elegant appearance with high gloss and exceptional logo definition. Dissolution performance of ibuprofen tablets coated with the novel IR system remain consistent following six months accelerated storage stability testing.

References

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