



## **COMPARISON OF PERFORMANCE OF SPRAY NOZZLES FROM LEADING MANUFACTURERS**

### **Aim/Objective:**

The objective of this study is to perform a comparative study to check the performance of Gansons High Performance Nozzle – 3<sup>rd</sup> Generation (GHPN III<sup>RD</sup>) with other available nozzles.

### **Abstract:**

Spray nozzles are commonly used in tablet coating applications to provide a finely atomized spray, which adheres to the tumbling tablets to form a thin, uniform coating. In aqueous film coating, its coating uniformity is critical. Slight changes in coating uniformity or thickness can cause adversely affect the product quality and be a potential substandard product.

Hence, any discrepancies in coating uniformity must be quickly corrected. These corrections often require shutdowns and cause loss of productivity and profitability. The spray nozzles used these days in tablet coaters are anti-bearding (**bearding**: A phenomena in which nozzle is prone to collect deposits on the exit orifice).

The Gansons spray nozzle GHPN III<sup>RD</sup> has been designed and developed from our popular RAU nozzles, incorporating performance features associated with those nozzles. This now represents cutting edge technology, striving to provide outstanding and consistent results. In delivering effective and highly controlled film coating onto solid dosage products, the latest spray nozzle incorporates many clever design features. A series of spray manifolds have also been developed with enhanced aerodynamic properties to minimise air consumption, thus reducing the risk of unwanted spray drying with the associated inefficiencies. These factors coupled with utilising the latest anti-bearding technology eliminate the time lost which is required for stopping the process to clean the air caps. The purpose of this work is to compare the performance of Gansons High Performance Nozzle as GHPN-III<sup>RD</sup> with RAU and a hornless nozzle manufactured in Germany.

### **Methodology:**

Three types of nozzles were tested under laboratory conditions and compared.

- 1) Coating trial was performed with each nozzle using aqueous and organic vehicle to analyse the performance with defined number of parameters. Baseline testing was performed with water & IPA.



All subsequent testing were performed using an Instacoat™ 4G (35% Solid Dispersion) for Aqueous Based coating & Instacoat Universal (9% Solid Content) for Hydro-alcoholic vehicle based coating sourced from Ideal cures Pvt. Ltd.

2) Spray distribution pattern data was collected at a constant spray distance of 15 cm.

#### Testing Nozzle:

- Gansons High Performance Nozzle (GHPN-III<sup>RD</sup>)
- German made Nozzle
- Gansons RAU Nozzle

#### Coating Process:

##### a) Coating Trial

In case of aqueous solvent system, Instacoat 4G (procured from Ideal Cures Pvt. Ltd., India is a high solids aqueous coating formulation) was reconstituted in water at 35 % solids concentration and stirred for 45 minutes. Coating suspension was filtered through 100# sieve prior to coating process. Trials were performed at Ideal cures Pvt. Ltd. using Gansons Auto-Coater GAC 600 (Pan Size: 24"). Trials were conducted on round shaped tablets (11.8 mm with Instacoat logo on both the sides), Pan Load: 10 kg placebo tablets, avg. wt.: 480 mg, target was 3% weight gain and gun to bed distance was kept 14 cm.

<b>Nozzle Type</b>	<b>German made</b>	<b>RAU Nozzle</b>	<b>GHPN-III<sup>RD</sup> Nozzle</b>
<b>Parameters</b>	<b>Nozzle</b>		
<b>Inlet Temperature (°C)</b>	68-70	68-70	68-70
<b>Exhaust Temperature (°C)</b>	58-60	63-65	63-65
<b>Inlet Fan RPM*</b>	2500	2500	2500
<b>Exhaust Fan RPM**</b>	1650	1650	1650
<b>Atomization Pressure (Kg/cm<sup>2</sup>)</b>	2.2	2.2	2.2
<b>Fan Air Pressure (Kg/cm<sup>2</sup>)</b>	3.0	3.0	1.8
<b>Pan RPM</b>	11-13	11-13	11-13
<b>Spray Rate (gm/min)</b>	20-25	20-25	20-25
<b>Pan Differential Pressure (mmWc)</b>	5-6	5-6	5-6

\*Max Inlet Fan RPM – 2880 corresponds to 350 CFM

\*\* Max Exhaust Fan RPM – 2880 corresponds to 600 CFM



In case of hydro-alcoholic solvent system, Instacoat Universal (from Ideal Coat is a HPMC based film coating system available with different solvent systems) was reconstituted in isopropyl alcohol: Water (70:30) at 9% w/w solids concentration and stirred for 30 minutes. Coating suspension was filtered through 100# prior to coating process. The coating trial was performed in GansCoater<sup>®</sup> using same tablets (tablets with Instacoat logo on both sides).

<b>Nozzle Type</b> <b>Parameters</b>	<b>German made</b> <b>Nozzle</b>	<b>RAU Nozzle</b>	<b>GHPN-III<sup>RD</sup> Nozzle</b>
<b>Inlet Temperature (°C)</b>	62-65	63-65	63-65
<b>Exhaust Temperature (°C)</b>	52-55	53-55	53-55
<b>Inlet Fan RPM*</b>	2500	2880	2880
<b>Exhaust Fan RPM**</b>	1900	2210	2210
<b>Atomization Pressure (Kg/cm<sup>2</sup>)</b>	2	1.2	1.0
<b>Fan Air Pressure (Kg/cm<sup>2</sup>)</b>	3	2.0	<b>1.2</b>
<b>Pan RPM</b>	11-13	9.5-12	9.5-12
<b>Spray Rate (gm/min)</b>	40-50	50-60	50-60
<b>Pan Differential Pressure (mmWc)</b>	5	5	5

\*Max Inlet Fan RPM – 2880 corresponds to 350 CFM

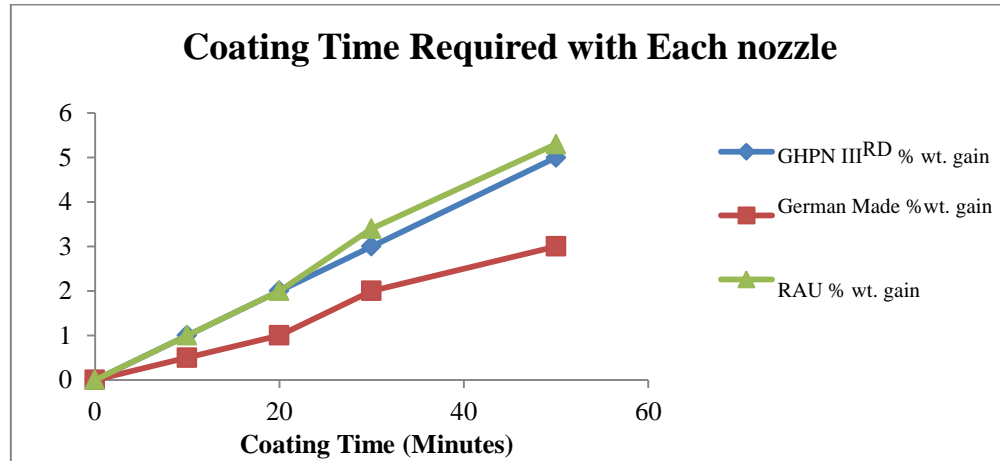
\*\* Max Exhaust Fan RPM – 2880 corresponds to 600 CFM

b) Spray pattern of each type of nozzle was observed by keeping a paper at a distance of 14 cm.

### **Results:**

#### **1) Aqueous Based Coating:- (3% wt. gain)**

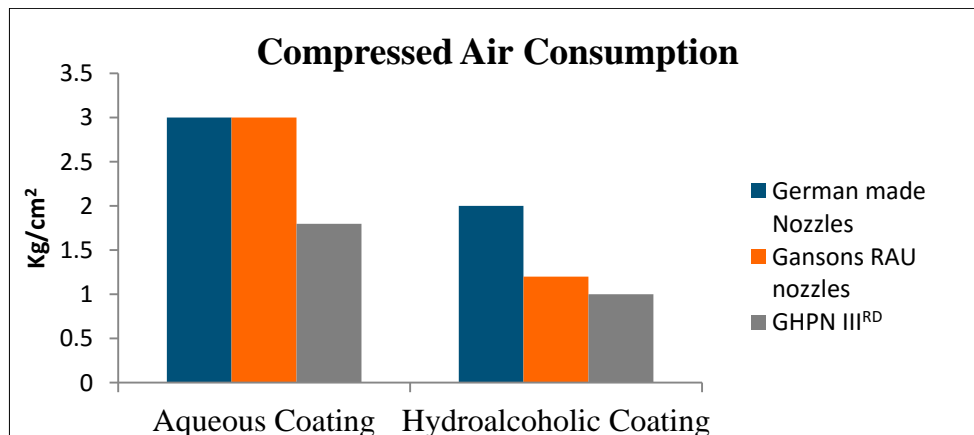
<b>Parameters</b>	<b>German made</b> <b>Nozzle</b>	<b>RAU Nozzle</b>	<b>GHPN-III<sup>RD</sup> Nozzle</b>
<b>Initial Coating Solution Qty.</b>	1020 gm	1020 gm	1020 gm
<b>Coating Solution saving</b>	75 gm	180 gm	269 gm
<b>Approximate Process time</b>	47 Min	28 min	33 min
<b>Appearance</b>	Smooth surface, No logo filling was observed.	Smooth and glossy surface, No logo filling was observed.	Smooth and glossy surface, No logo filling was observed.



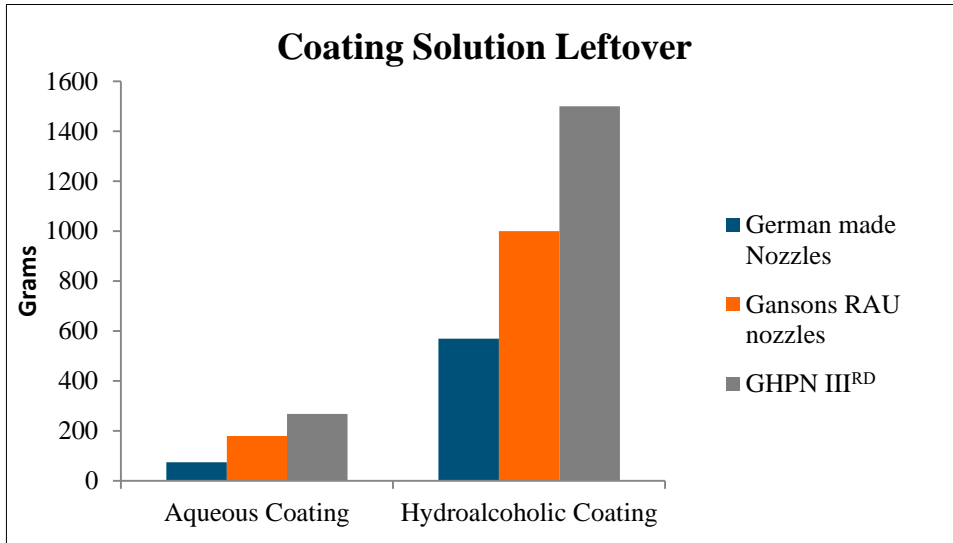
**Fig.: Coating time required vs. % wt. gain graph.**

**2) Hydro-alcoholic Based Coating:- (For 2% weight gain)**

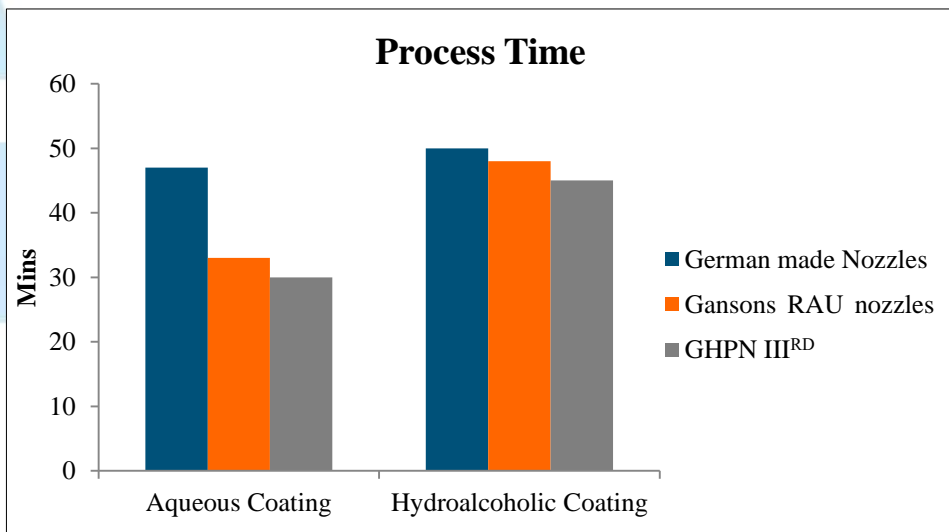
Parameters	German made Nozzle	RAU Nozzle	GHPN-III <sup>RD</sup> Nozzle
Initial Coating Solution Qty.	4000 gm	4000 gm	4000 gm
Coating Solution remaining	570 gm	1000 gm	1500 gm
Approximate Process time	60 min	50 min	45 min
Appearance	Smooth surface, No logo filling was observed.	Smooth surface, No logo filling was observed.	Smooth and glossy surface, No logo filling was observed.



- **40% less compressed air consumption**

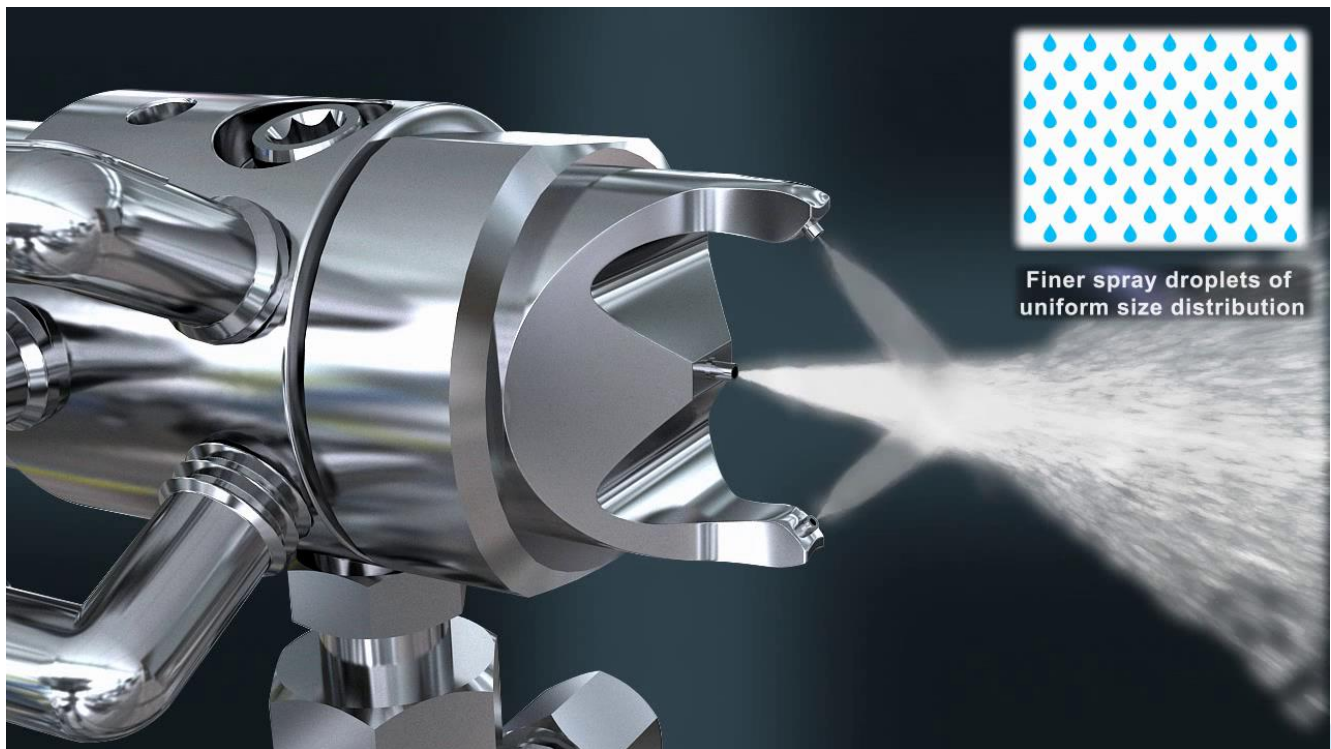


- 20% savings in overages

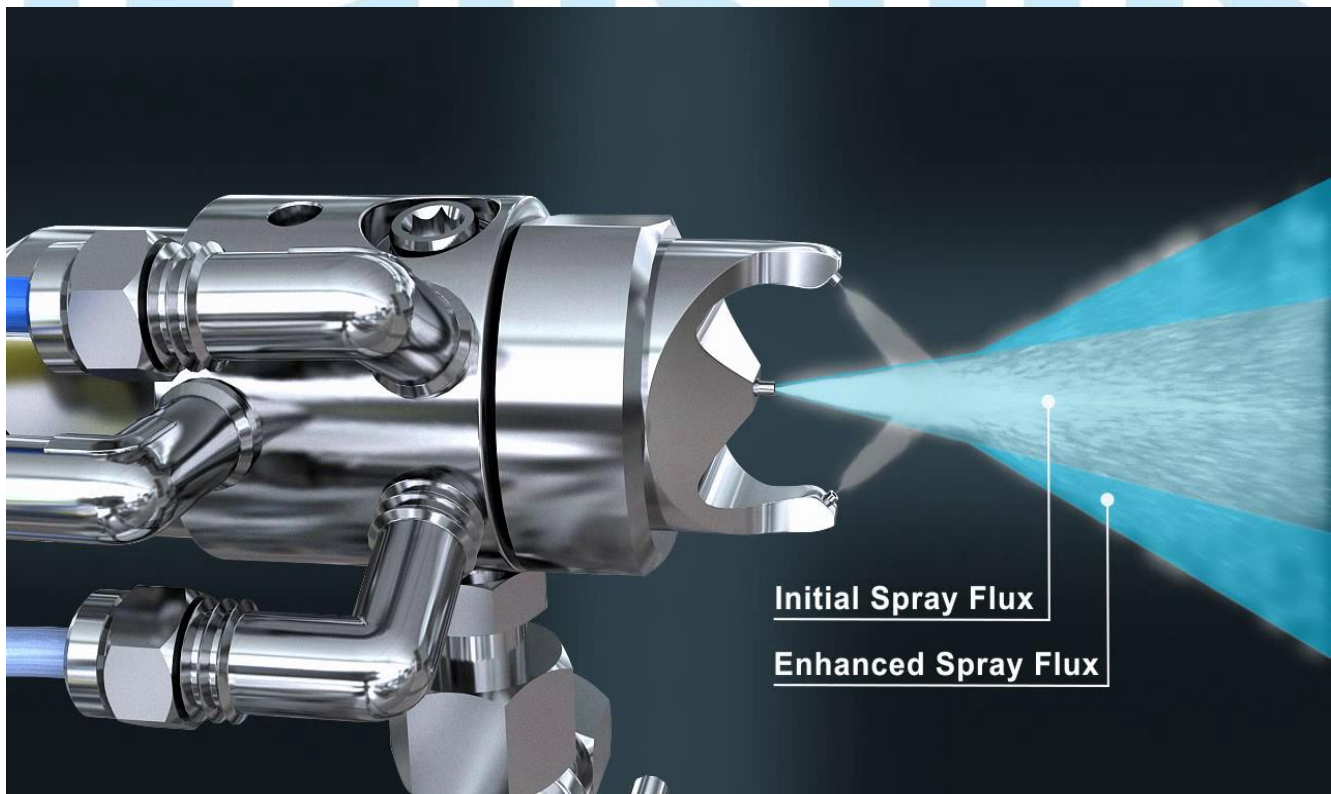


- 10% savings in time

**Spray Pattern:**



**Fig.: GHPN-III<sup>RD</sup> Nozzle Spray Pattern**



**Fig.: GHPN-III<sup>RD</sup> Nozzle Spray Pattern Explained mechanism**



**Fig: German made Spray Nozzle Spray pattern**

**Observations:**

Uniform droplet size



Fig.: GHPN-III<sup>RD</sup> Spray Pattern

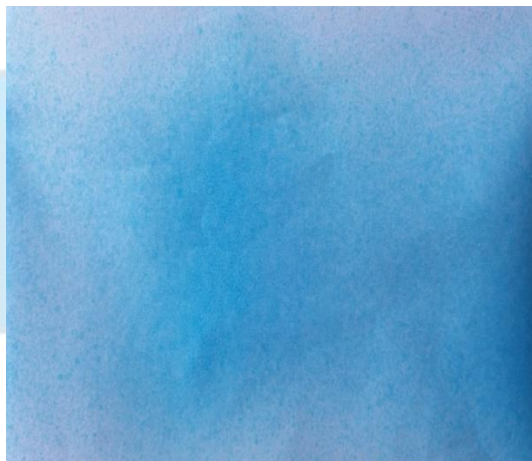


Fig.: RAU Spray Pattern



Fig.: German made nozzle Spray Pattern



Fig.: German made Spray Pattern



### **Conclusion:**

After series of coating trials performed with all three nozzles it was found that Gansons High performance nozzle was able to reduce the air consumption for both aqueous and hydro-alcoholic based coating. The spray gun nozzle design has a strong influence on spray geometry, its dynamics characteristics and coating properties. A minor modification of spray gun nozzle design can strongly improve the coating characteristics. The spray pattern of GHPN III<sup>RD</sup> Nozzle was found to be more uniform in terms of droplet size as compared to the other two nozzles.

### **Acknowledgement:**

This work is supported by **Ideal Cures Pvt. Ltd.** on material (Instacoat 4G & Universal, Machine GAC 600). Gansons would like to thank **Mr. Suresh Pareek** for his useful contribution to the same.

**Instacoat 4G:** INSTACOAT 4G<sup>TM</sup> is IDEAL CURES revolutionary high solids aqueous coating formulation which can be reconstituted up to 35% solids.

**Instacoat Universal:** It is a HPMC based film coating system available with different solvent system (Aqueous, Organic and Hydro-alcoholic) and reconstitution levels.

Gansons

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