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Pharmaceutical Sciences **RESEARCH ARTICLE ……!!!**

EFFECT OF DIFFERENT TEMPERATURE AND RELATIVE HUMIDITY ON PACKED AND UNPACKED PHARMACEUTICAL EXCIPIENT HICEL™ MICROCRYSTALLINE CELLULOSE

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KEYWORDS:

HiCel™XLM90 Microcrystalline Cellulose, HiCel™90M Microcrystalline Cellulose, Moisture content, tensile strength.

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ABSTRACT

Microcrystalline cellulose (MCC) is a very popular excipient in pharmaceutical market. Consumption of MCC is increasing day-by-day. Influence of temperature and relative humidity (RH) on microcrystalline cellulose changes physical parameter of MCC such as moisture content, bulk density, Carr's index and flow. Moisture content variation has effect on tablet hardness and friability of tablet. Two grades of HiCel™ MCC are used in this study, one is HiCel™XLM90 (it is extra low moisture grade of HiCel™ MCC, other properties are same as HiCel™90M MCC) and second is HiCel™90M MCC. In this study, we will investigate the effect of different temperature and relative humidity on packed and unpacked microcrystalline cellulose HiCel™XLM90 and HiCel™90M during 30 hrs. Both packed and unpacked grades of HiCel™ were taken and sampling was done at different-different time intervals, to evaluate physical parameters of MCC. Tablets were made from all samples. Tablet parameters like test hardness, weight variation and friability were evaluated.

INTRODUCTION

Many excipients are used in pharmaceutical industries for manufacture of solid oral dosage forms. Excipients are used as a bulking agents in formulation, but is should be non-reactive and enhance tabletting properties. Microcrystalline cellulose is a dried binder and native form of cellulose[1]. The development of microcrystalline cellulose (MCC) has made available to the pharmaceutical industry an extremely valuable tabletting binding agent[2]. MCC has good binding, lubricating and self-disintegrating properties. It is used as filler in hard gelatin capsules[3]. In market, MCC is available with many trade mark i.e. HiCel™, Avicel, EmcoCel, Microcel and AceCel™.

HiCel™ Microcrystalline cellulose is most abundant natural linear polymer made up of beta (1-4) linked D-glucose repeat units. It is produced by hydrolysis with dilute mineral acid at required temperature until less than 350 degree of polymerization is reached[4]. Currently spray dried MCC powder such as HiCel™90M. HiCel™XLM90, HiCel™50M, HiCel™12 and HiCel™14 are the most frequently and widely used in direct compressible tablets. HiCel™12 has excellent flow and compaction properties. HiCel™XLM90M and HiCel™14 are used for extreme water sensitive drugs, both grades of HiCel™ are low moisture grade. Moisture and relative humidity can affect the physical properties of MCC powder such as Moisture content, flow and Carr's index and its tablet properties also[5,6]. The mechanical and disintegration properties of microcrystalline cellulose tablet are related to their moisture content and water uptake capacity, respectively[7]. Moisture in microcrystalline cellulose could be absorbed in different physical states (A) Absorbed by monolayer on the surface of the particle, (B) Absorbed by multilayer on the surface of the particles,(C) Water condensed on the surface of particle (D) Physically absorbed water within the particle and (E) Chemisorbed water. Distribution of water depends on the powder and the amount of moisture absorbed through exposure to humid air [8].

In this study, we elucidate effect of different temperature and different humidity on HICel™90M and HiCel™XLM90M MCC in unpacked and packed conditions. In this study, we will use three different humidity and temperature i.e.65% RH and 30 °C, 75% RH and 40°C and at ambient conditions temperature was 25°C±3°C and relative humidity was 42%±10%for 30 hrs. In 30 hrs we observed the changes in physical properties of both HiCel™MCC grades and tabletting properties also [9].

MATERIAL AND METHOD

MATERIAL

This study was done on two different grades of HiCel™MCC (HiCel™90M and HiCel™XLM90). Two Stability Chambers (Labindia, Model no-TS0000325 S) were used for state of water in

HiCel^{TM}MCC. Digital weighing balance (Model no-ML802/A01, MS 303 S/A01, MS204S /A01) were used for weighting the sample. A graduated measuring cylinder was used for checking untapped density and tapped density (Electro lab instrument, model No.ETD1020) of HiCel^{TM}MCC. Hot air oven (Model no-PNX-14) was used for testing moisture content. Proton mini press "D" type tooling machine (model 10 STN "D") was used for making the tablets. Digital tablet hardness tester (Labindia model no.TH1050M) was used for testing tablet hardness. Friability tester (Labindia, model no- FT 1020) was used for analysis of tablet friability test.

METHOD

STATE OF WATER IN HiCel^{TM}MCC [9]

In this study, we have used two grades of HiCel^{TM} MCC (HiCel^{TM}90M and HiCel^{TM}XLM90) and carried out moisture sorption with two types conditions packed primary packing with polyethylene liner and secondary packing with paper bag and unpacked. whereas unpacked sample exposed in a glass tray at three different condition : (1) 65% RH, 30°C, (2) 75% RH, 40°C using stability chambers (Labindia, Model no-TS0000325 S) and (3) ambient condition (temperature 25 °C±3 °C and relative humidity was 42% ±10%) for 30 hrs. Took samples at different-different time intervals from each (intervals mentioned in the table).

MOISTURE CONTENT [10]

Heat the shallow bottle in a hot air oven (Model no. PNX-14) at 105°C for 30 minutes after that cool it in desiccator at room temperature. Tare weight the Shallow bottle and take about 1 gm of MCC sample in shallow bottle, set oven at 105°C and kept for 3 hours. After 3 hours take out the shallow bottle allow to cool in desiccator at room temperature. When the shallow bottle is cool take weight again, Calculate moisture content by using the following formula.

$$\text{Moisture content} = \frac{After\ \ drying\ \ weig\,ht\ of\ \ shallow\ \ bottle - empty\ \ \ weig\,ht\ of\ \ shallow\ \ bottle}{Sample\ \ \ weig\,ht\ in\ \ gram} \text{ X } 100$$

ANGLE OF REPOSE[5]

Pour 30g of dry MCC through pour on powder flow tester (#10 mesh size), powder comes on the S.S cylinder surface until a pile build on the top of S.S cylinder. Measure the total height (S.S cylinder & pile) by scales. Using following formula find the calculated value this value check natural tangents chart for angle of repose and reported.

$$\text{Angle of Repose} = \frac{2h}{d}$$

Where

h = height of S.S cylinder

d = diameter of S.S cylinder

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BULK DENSITY

UNTAPPED DENSITY[10]

Untapped density is analyzed through graduated measuring cylinder class A. Take 20 gm of MCC sample using weight balance (Toledo, Model No.-ML 802 /A01) and poured into a graduated A grade 100 ml capacity cylinder slowly from the sidewall. Level the surface of sample in cylinder by slow movement and note down the occupied volume and calculate the untapped density of MCC by using following formula.

$$\text{Untapped density} = \frac{Weight\ of\ powder\ \ in\ gram}{Occupied\ \ volume\ \ in\ mL}$$

TAPPED DENSITY[1]

Tapped density was anlaysed by using (Electro lab instrument, Model No. ETD1020), measuring cylinder placed in tapped density machine and fixed 500 tapped. After 500 tappe measured the volume of measuring cylinder and calculate the tapped density by using following formula.

$$\text{Tapped density} = \frac{Weight\ of\ powder\ \ in\ gram}{Occupied\ \ volume\ \ in\ mL}$$

HAUSNER'S RATIO[1]

Hausner ratio is another method to check flow of powder. The flow of powder was measured by "Hausner ratio". Tapped density is divided by untapped density . Formula is mention below.

$$\text{H.Ratio} = \frac{Tapped\ \ density}{Untapped\ \ density}$$

CARR'S INDEX[11]

Carr's index is known as Compressibility index, it is indicate compressibility of powder. Carr's index calculated by following formula.

$$\text{Carr's index} = 100 \times \frac{Tapped\ \ density\ -Untapped\ \ \text{density}}{Tapped\ \ density}$$

TABLET COMPACTION[12]

Compacts of ~500 mg tablet were made on 10 station proton mini press (Model no. MINI PRESS 10 "D") using D tooling dies and punches. Machine operating pressure range 10 to 60 KN.

WEIGHT VARIATION OF TABLETS[12]

Random 10 tablets were taken from each batch and each tablet was weighted individually using electronic digital balance (Mettler Toledo, Model No.-MS204S /A01). The average weight of all tablets was calculated following formula.

$$Average\ weight\ of\ tablet = \frac{Total\ \ weight\ of\ tablets}{Total\ \ no.of\ \ tablets}$$

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HARDNESS OF TABLET[12]

Random 10 tablets were taken from each batch. Electronic digital hardness test machine (Labindia tablet hardness tester, Model No.-TH1050 M) was used for hardness test. Individually, a tablet was placed between two anvils, force was applied to the anvils, and the crushing strength that just caused the tablet to break was recorded. Finally the reading was taken in kp[kgf] on display of hardness machine.

FRIABILITY OF TABLET[12]

At first 10 tablets were taken. The tablets were carefully dusted prior to testing, then the 10 tablets were weighted electronic digital balance (Mettler Toledo, Model no. MS303/A01). Which was considered as the initial reading. After weight the tablets, all the tablets were placed in the drum of friability tester and rotate 100 times at 25 rpm. After 100 revolutions the 10 tablets were removed and re-weighted. This was the final reading. The percentage was calculated by following formula (equation 3). According to USP the tablets should not lose more than 1% of their total weight.

$$\%\ Friability = \frac{Tablet\ \ weig\,ht\ befor\ \ friability\ \ - Tablet\ \ weig\,ht\ After\ \ friability}{Tablet\ \ weig\,ht\ beforefriability} \times 100$$

ABBREVIATIONS

MCC: Microcrystalline cellulose, XLM: Extra low moisture, RH: Relative humidity, BD: Bulk density, USP: United State Pharmacopoeia, S.S: Stainless steel, g: gram, mg: milligram, KN: Kilonewton.

RESULT

State of water in HiCel^{TM}MCC

Took sample for analysis from both packed and unpacked condition and withdrawal samples at different- different time intervals (Time intervals detail mention in table no.1 and 2)

Moisture Content

There are no changes observed in packed sample but some changes observed in unpacked sample, result mentioned in table no.1 and Fig.no.1. Unpacked HiCel^{TM} XLM90 result mentioned in table no.2 and fig.no.2. Percentage of moisture absorption of both MCC grades are mention in fig no.3 and fig no.4.

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Table no.1. Physical analysis detail of HiCel^{TM}90M with time intervals and storage condition

HiCel^{TM}90M Microcrystalline Cellulose							
Time intervals (Hrs)	**Sample storage conditions (Temperature/Relative Humidity)**	**Moisture content (%)**	**Bulk density(g/cc)**		**H. Ratio**	**Carr,s Index**	**Angle of Repose**
			Untapped	**Tapped**			
0	Initial	4.30	0.32	0.46	1.44	30.43	39°50’
1	30°C/65 RH	4.41	0.32	0.46	1.44	30.43	39°50’
	40°C/75 RH	4.45	0.32	0.46	1.44	30.43	39°50’
	Ambient Condition	4.41	0.32	0.46	1.44	30.43	39°50’
2	30°C/65 RH	4.46	0.32	0.46	1.44	30.43	39°50’
	40°C/75 RH	4.49	0.32	0.46	1.44	30.43	41° 30’
	Ambient Condition	4.44	0.32	0.46	1.44	30.43	39°50’
3	30°C/65 RH	4.93	0.32	0.46	1.44	30.43	42° 50’
	40°C/75 RH	4.98	0.32	0.46	1.44	30.43	42° 50’
	Ambient Condition	4.45	0.32	0.46	1.44	30.43	41° 20’
4	30°C/65 RH	5.06	0.32	0.46	1.44	30.43	43° 50’
	40°C/75 RH	5.10	0.32	0.46	1.44	30.43	43° 50’
	Ambient Condition	4.66	0.32	0.46	1.44	30.43	42° 30’
5	30°C/65 RH	5.57	0.31	0.45	1.45	31.11	45°
	40°C/75 RH	5.63	0.31	0.45	1.45	31.11	45°
	Ambient Condition	4.86	0.32	0.46	1.44	30.43	43° 50’
6	30°C/65 RH	5.75	0.31	0.45	1.45	31.11	46° 10’
	40°C/75 RH	5.86	0.31	0.45	1.45	31.11	47° 20’
	Ambient Condition	4.98	0.32	0.46	1.44	30.43	43° 50’
7	30°C/65 RH	6.19	0.31	0.45	1.45	31.11	48° 30’
	40°C/75 RH	6.25	0.31	0.45	1.45	31.11	48° 30’
	Ambient Condition	5.07	0.32	0.46	1.44	30.43	43° 50’
8	30°C/65 RH	6.29	0.31	0.45	1.45	31.11	48° 30’
	40°C/75 RH	6.34	0.31	0.45	1.45	31.11	49° 30’
	Ambient Condition	5.12	0.32	0.46	1.44	30.43	43° 50’
12	30°C/65 RH	6.36	0.31	0.45	1.45	31.11	49° 30’
	40°C/75 RH	6.43	0.31	0.45	1.45	31.11	49° 30’
	Ambient Condition	5.15	0.31	0.45	1.45	31.11	45°
20	30°C/65 RH	6.46	0.31	0.45	1.45	31.11	49° 30’
	40°C/75 RH	6.48	0.31	0.45	1.45	31.11	49° 30’
	Ambient Condition	5.23	0.31	0.45	1.45	31.11	45°
24	30°C/65 RH	7.13	0.31	0.45	1.45	31.11	50° 30’
	40°C/75 RH	7.11	0.31	0.45	1.45	31.11	50° 30’
	Ambient Condition	7.09	0.31	0.45	1.45	31.11	46° 10’
30	30°C/65 RH	7.13	0.31	0.45	1.45	31.11	50° 30’
	40°C/75 RH	7.11	0.31	0.45	1.45	31.11	50° 30’
	Ambient Condition	7.09	0.31	0.45	1.45	31.11	46° 10’
Note – No change in packed HiCel^{TM}90M MCC at all three conditions.							

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Table no.2. Physical analysis detail of HiCel™XLM90 with time intervals and storage condition

HiCel™XLM90M Microcrystalline Cellulose							
Time intervals (Hrs)	**Sample storage conditions (Temperature/Relative Humidity)**	**Moisture content (%)**	**Bulk density(g/cc)**		**H. Ratio**	**Carr,s Index**	**Angle of Repose**
			Untapped	**Tapped**			
0	Initial	1.30	0.29	0.42	1.45	29.27	35°
1	30°C/65 RH	2.75	0.29	0.41	1.41	29.27	37°
	40°C/75 RH	2.97	0.29	0.41	1.41	30.95	38°30’
	Ambient Condition	1.86	0.29	0.42	1.45	29.27	35°20’
2	30°C/65 RH	3.45	0.29	0.41	1.41	29.27	37°
	40°C/75 RH	3.47	0.29	0.41	1.41	29.27	38°30’
	Ambient Condition	2.47	0.29	0.42	1.45	30.95	35°20’
3	30°C/65 RH	3.75	0.29	0.41	1.41	29.27	38°30’
	40°C/75 RH	3.91	0.29	0.41	1.41	29.27	39°50’
	Ambient Condition	2.56	0.29	0.41	1.41	29.27	37°
4	30°C/65 RH	4.36	0.29	0.41	1.41	29.27	38°30’
	40°C/75 RH	4.44	0.28	0.41	1.46	31.70	39°50’
	Ambient Condition	3.49	0.29	0.41	1.43	29.27	37°
5	30°C/65 RH	4.97	0.29	0.41	1.46	29.27	38°30’
	40°C/75 RH	4.99	0.28	0.41	1.46	31.70	39°50’
	Ambient Condition	4.39	0.29	0.41	1.41	29.27	37°
6	30°C/65 RH	5.02	0.28	0.41	1.46	31.70	39°50’
	40°C/75 RH	5.07	0.28	0.41	1.46	31.70	40°20’
	Ambient Condition	4.89	0.29	0.41	1.41	29.27	37°
7	30°C/65 RH	5.26	0.28	0.41	1.46	31.70	39°50’
	40°C/75 RH	5.34	0.28	0.41	1.46	31.70	40°20’
	Ambient Condition	4.93	0.29	0.41	1.41	29.27	37°
8	30°C/65 RH	5.62	0.28	0.40	1.43	30.00	40°20’
	40°C/75 RH	5.67	0.28	0.40	1.43	30.00	42°30’
	Ambient Condition	4.96	0.29	0.41	1.41	29.27	38°30’
12	30°C/65 RH	6.62	0.28	0.40	1.43	30.00	40°20’
	40°C/75 RH	6.64	0.28	0.40	1.43	30.00	45°30’
	Ambient Condition	5.19	0.29	0.41	1.41	29.27	39°30’
20	30°C/65 RH	6.62	0.28	0.40	1.43	30.00	40°20’
	40°C/75 RH	6.67	0.28	0.40	1.43	30.00	47°20
	Ambient Condition	5.20	0.29	0.41	1.41	29.26	45°30,
24	30°C/65 RH	6.97	0.28	0.40	1.43	30.00	49°50’
	40°C/75 RH	6.89	0.28	0.40	1.43	30.00	47°20
	Ambient Condition	6.96	0.28	0.40	1.43	30.00	49°50,
30	30°C/65 RH	6.97	0.28	0.40	1.43	30.00	50°
	40°C/75 RH	6.89	0.28	0.40	1.43	30.00	47°20
	Ambient Condition	6.96	0.28	0.40	1.43	30.00	49°50,
Note – No change in packed HiCel™XLM90 MCC at all three conditions.							

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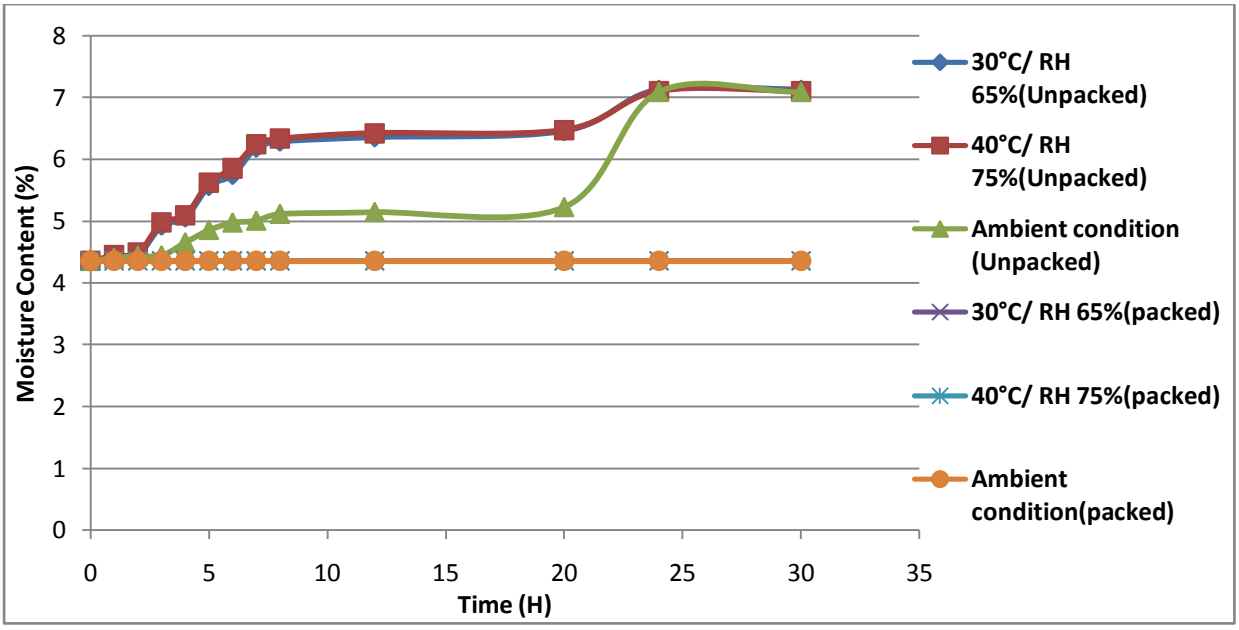

Fig no.1.Moisture content of packed and unpacked of three different condition at different-different time intervals of HiCel^{TM}90M MCC.

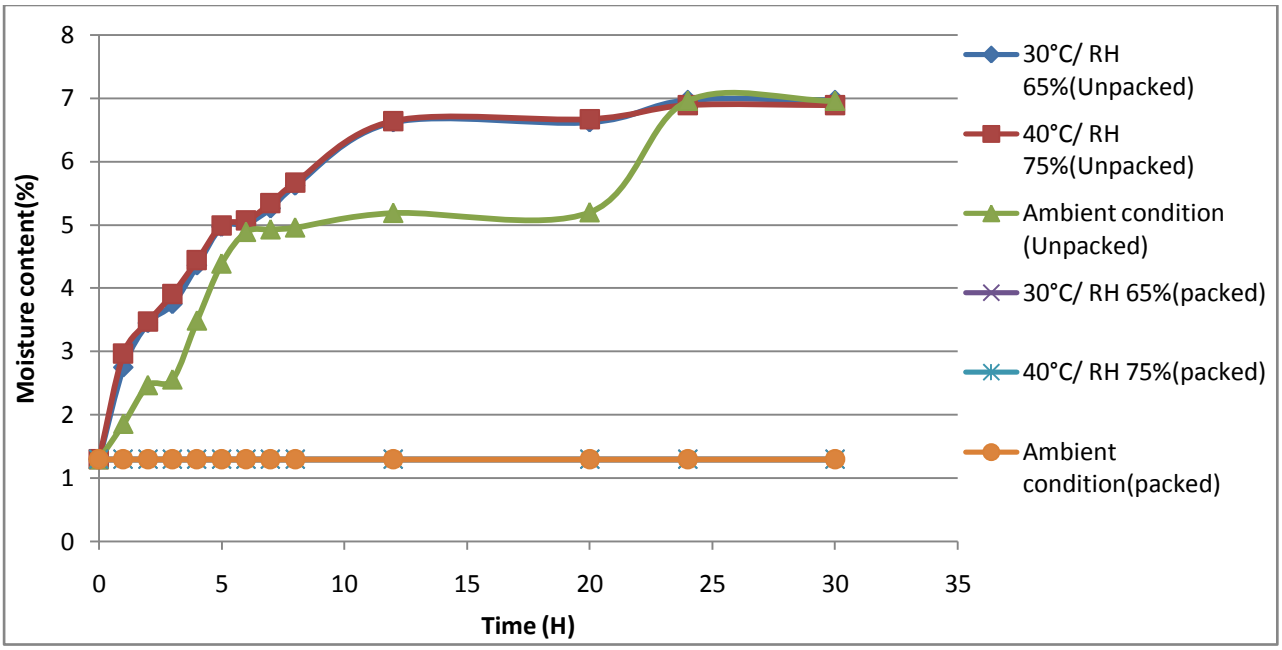

Fig no.2.Moisture content of packed and unpacked of three different condition at different-different time intervals of HiCel^{TM}XLM90 MCC.

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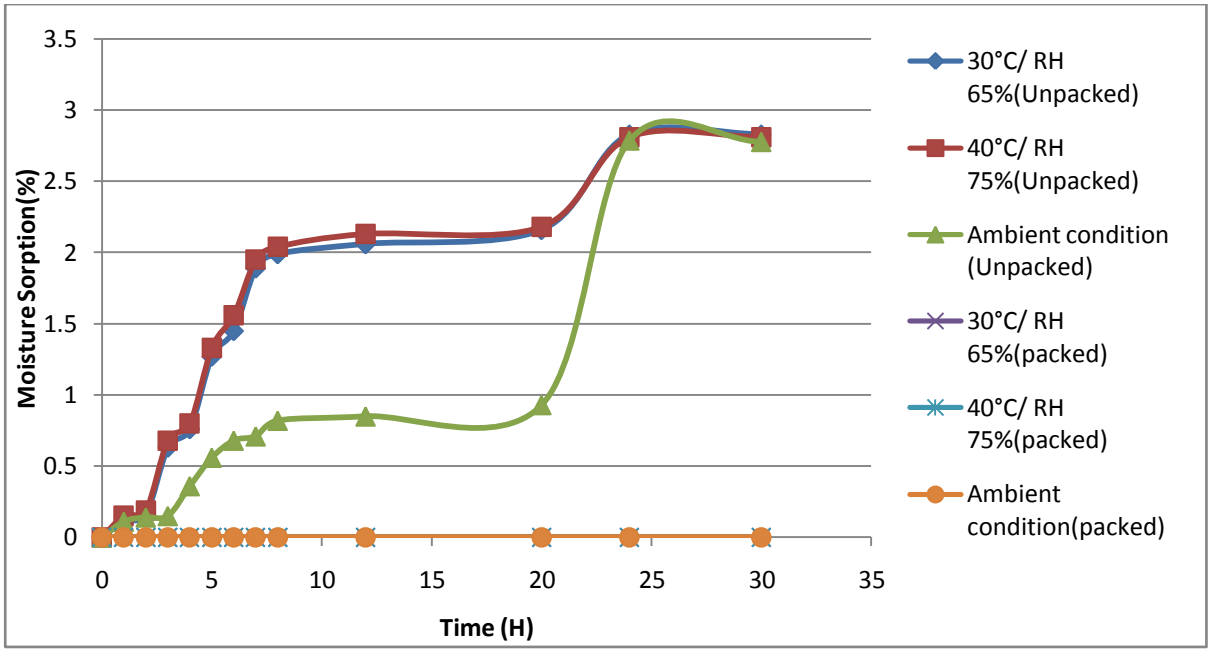

Fig no.3.Percentage of moisture absorption of packed and unpacked of three different condition at different-different time intervals of HiCel^{TM}90M MCC.

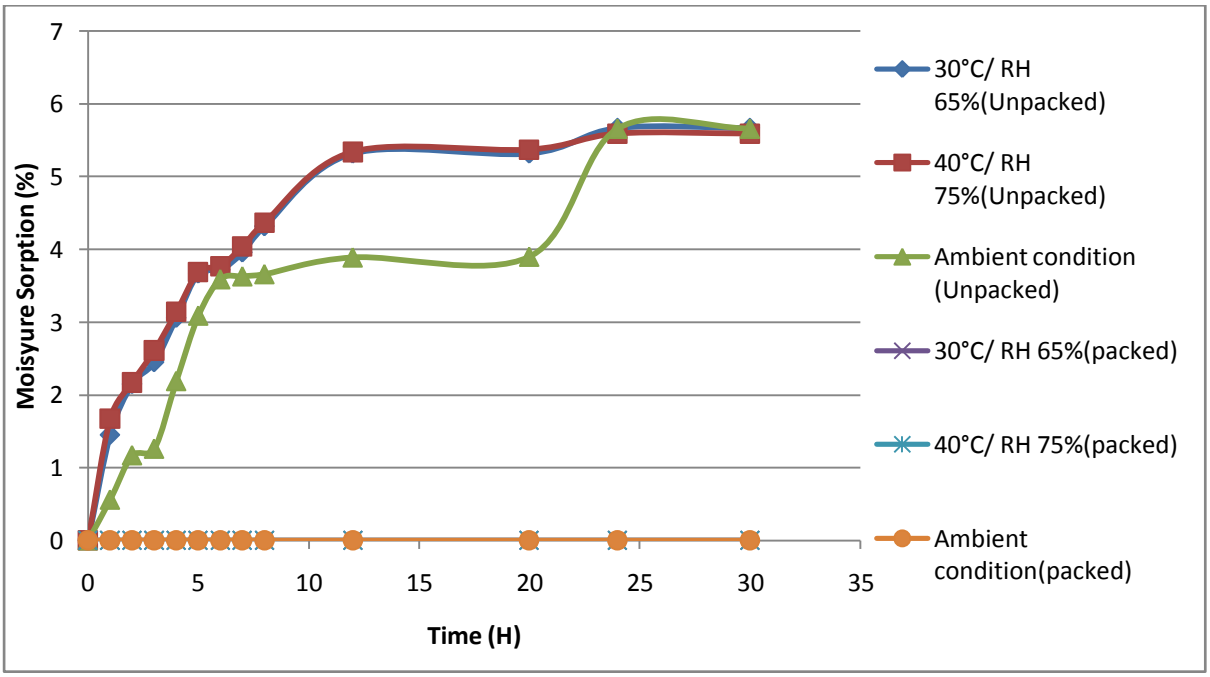

Fig no.4.Percentage of moisture absorption of packed and unpacked of three different condition at different-different time intervals of HiCel^{TM}XLM90 MCC.

Angle of repose

Angle of repose of packed and unpacked HiCel^{TM}90M grade of MCC mentioned in fig.no.5. and packed and unpacked of HiCel^{TM}XLM90 grade of MCC mentioned in fig.no.6.

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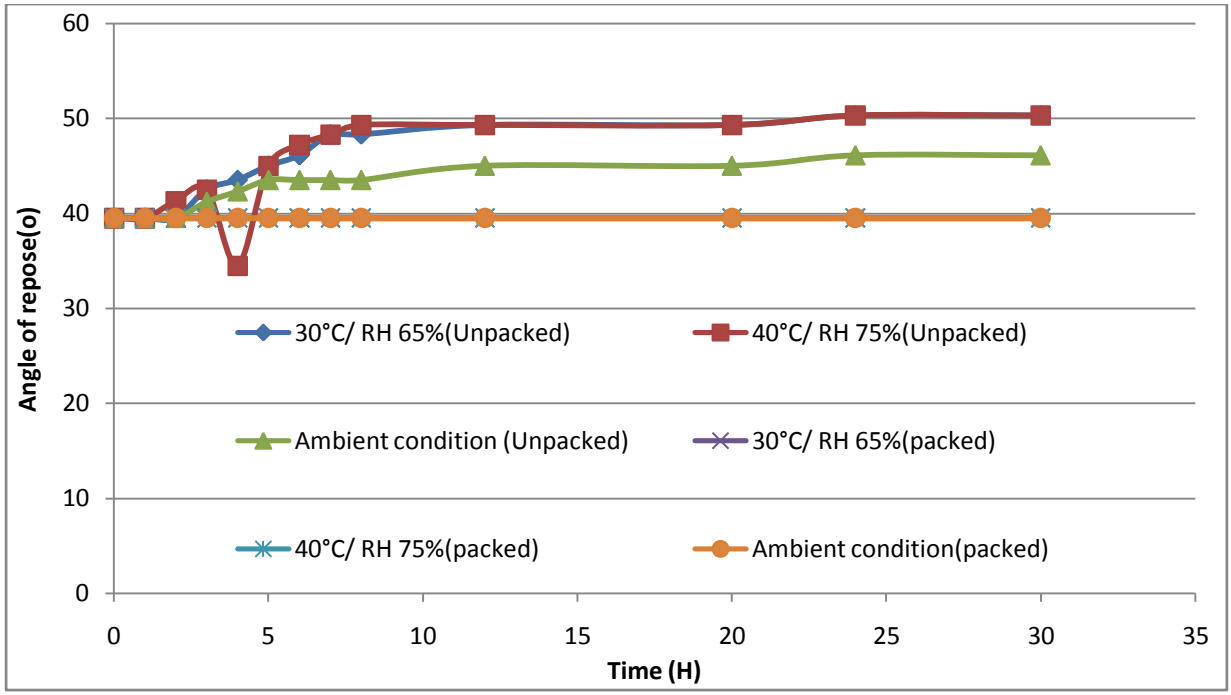

Fig no.5.Angle of repose of packed and unpacked of three different condition at different-different time intervals of HiCel^{TM}90M MCC.

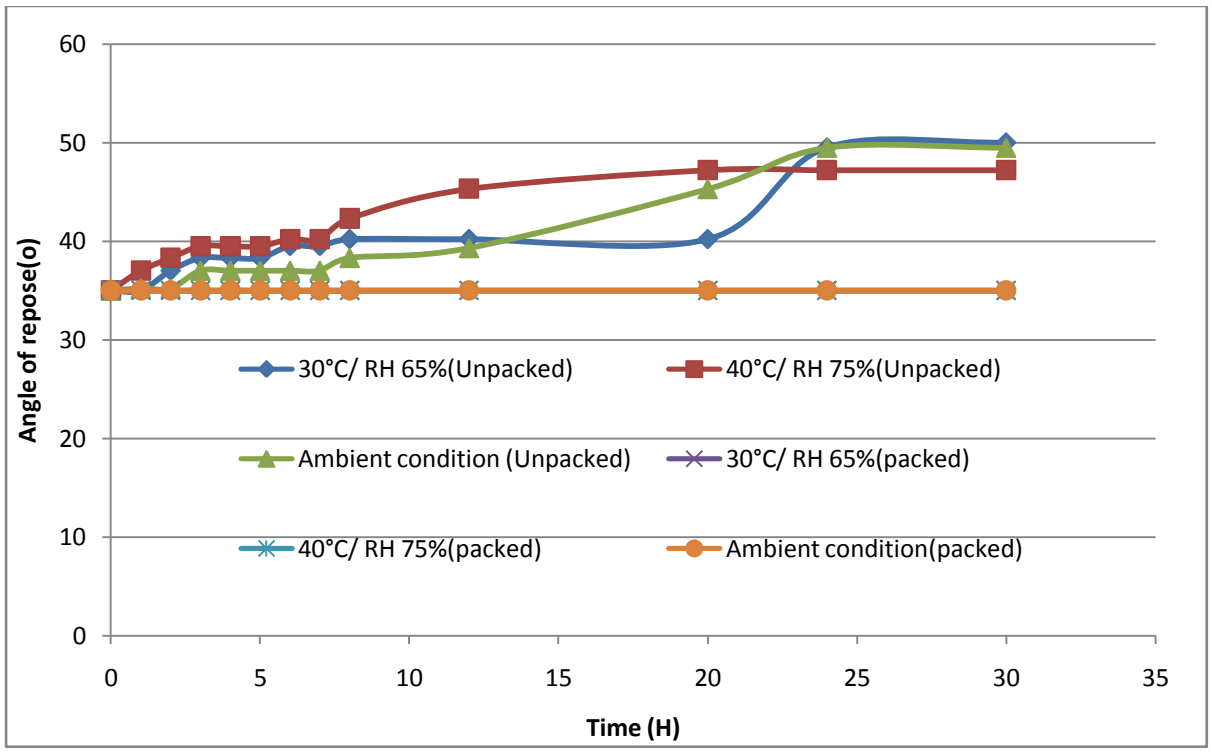

Fig no.6.Angle of repose of packed and unpacked of three different condition at different-different time intervals of HiCel^{TM}XLM90 MCC.

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Bulk density

Untapped and tapped density of both grades MCC (HiCel^{TM}90M and HiCel^{TM}XLM90) are not changed in packed condition, where as unpacked both grades of MCC varied and result is mention in table no.1 and table no.2 respectively.

Hausner ratio

Hausner ratio of both grades MCC (HiCel^{TM}90M and HiCel^{TM}XLM90) packed and unpacked result is mention in table no.1 and table no.2 respectively

Carr's index

Carr's index is known as Compressibility index. Both grades MCC (HiCel^{TM}90M and HiCel^{TM}XLM90) in packed conditions there are no change observed. Unpacked both MCC sample result is mention in table no.1 and table no.2 respectively

Tablet compaction

All tablets are manufactured at 32.50 KN compaction force. All tablets are white color and elongated shape and free from physical defects i.e. sticking, lamination smooth surface of tablets.

Weight variation

All tablets have~500 mg weight, as per USP accepted variation of ±5% for 500mg tablet weight. Average tablet weight of both grades (HiCel^{TM}90M and HiCel^{TM}XLM90) MCC, packed and unpacked mention in table no.3 and 4 respectively.

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Table no.3. Tablet profile analysis detail of HiCel™90M with time intervals and storage condition

Tablet profile of HiCel™90 Microcrystalline cellulose				
Time intervals (Hrs)	**Sample storage conditions (Temperature/Relative Humidity)**	**Average weight of tablet (mg)**	**Average hardness of tablet (mg)**	**Percentage of friability (%)**
0	Initial	500.02	12.39	0.18
1	30°C/65 RH	500.01	12.42	0.18
	40°C/75 RH	500.01	12.43	0.18
	Ambient Condition	500.05	12.41	0.18
2	30°C/65 RH	500.09	13.00	0.16
	40°C/75 RH	500.02	12.99	0.16
	Ambient Condition	500.06	12.98	0.16
3	30°C/65 RH	501.00	13.01	0.16
	40°C/75 RH	500.89	13.01	0.16
	Ambient Condition	500.20	13.00	0.16
4	30°C/65 RH	500.04	13.45	0.14
	40°C/75 RH	500.2	13.40	0.14
	Ambient Condition	500.6	13.28	0.15
5	30°C/65 RH	500.02	12.98	0.16
	40°C/75 RH	500.8	12.96	0.16
	Ambient Condition	500.08	13.3	0.15
6	30°C/65 RH	500.00	12.91	0.16
	40°C/75 RH	500.02	12.86	0.17
	Ambient Condition	500.2	13.20	0.15
7	30°C/65 RH	500.3	09.98	0.23
	40°C/75 RH	500.01	09.97	0.23
	Ambient Condition	500.02	13.50	0.13
8	30°C/65 RH	500.02	09.97	0.23
	40°C/75 RH	500.02	10.00	0.23
	Ambient Condition	500.02	13.01	0.16
12	30°C/65 RH	500.05	10.4	0.23
	40°C/75 RH	500.2	10.3	0.23
	Ambient Condition	501.00	13.04	0.16
20	30°C/65 RH	502.00	10.4	0.23
	40°C/75 RH	500.00	10.3	0.23
	Ambient Condition	500.00	13.00	0.16
24	30°C/65 RH	500.24	11.03	0.22
	40°C/75 RH	500.01	11.02	0.22
	Ambient Condition	500.19	13.01	0.16
30	30°C/65 RH	500.00	10.99	0.22
	40°C/75 RH	502.00	11.00	0.22
	Ambient Condition	500.00	13.10	0.16
Note – No change in packed HiCel™90M MCC at all three conditions.				

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Table no.4. Tablet profile analysis detail of HiCel™XLM90M with time intervals and storage condition

Tablet profile of HiCel™XLM90 Microcrystalline cellulose				
Time intervals (Hrs)	**Sample storage conditions (Temperature/Relative Humidity)**	**Average weight of tablet (mg)**	**Average hardness of tablet (mg)**	**Percentage of friability (%)**
0	Initial	500.02	4.9	0.49
1	30°C/65 RH	500.02	4.8	0.49
	40°C/75 RH	500.02	8.2	0.25
	Ambient Condition	500.02	5.2	0.49
2	30°C/65 RH	500.05	10.49	0.23
	40°C/75 RH	500.2	10.50	0.23
	Ambient Condition	501.00	8.2	0.25
3	30°C/65 RH	502.00	10.98	0.22
	40°C/75 RH	500.00	10.00	0.24
	Ambient Condition	500.00	8.4	0.25
4	30°C/65 RH	500.24	12.64	0.18
	40°C/75 RH	500.01	12.97	0.17
	Ambient Condition	500.19	10.50	0.23
5	30°C/65 RH	500.00	13.11	0.17
	40°C/75 RH	502.00	13.12	0.17
	Ambient Condition	500.00	12.97	0.18
6	30°C/65 RH	500.02	13.20	0.16
	40°C/75 RH	500.00	13.21	0.15
	Ambient Condition	500.01	13.24	0.15
7	30°C/65 RH	500.05	13.01	0.17
	40°C/75 RH	500.09	13.00	0.17
	Ambient Condition	500.02	13.30	0.16
8	30°C/65 RH	500.06	12.96	0.17
	40°C/75 RH	501.00	13.98	0.14
	Ambient Condition	500.89	13.40	0.15
12	30°C/65 RH	500.20	10.98	0.22
	40°C/75 RH	500.04	10.99	0.22
	Ambient Condition	500.2	13.04	0.16
20	30°C/65 RH	500.6	10.96	0.23
	40°C/75 RH	500.02	10.97	0.23
	Ambient Condition	500.8	13.00	0.16
24	30°C/65 RH	500.08	10.99	0.22
	40°C/75 RH	500.00	11.01	0.22
	Ambient Condition	500.02	13.10	0.16
30	30°C/65 RH	500.01	10.98	0.22
	40°C/75 RH	500.0	11.00	0.22
	Ambient Condition	500.01	13.00	0.16
Note – No change in packed HiCel™XLM90 MCC at all three condition.				

Hardness of tablet

Average hardness of both MCC grades (HiCel^{TM}90M and HiCel^{TM}XLM90) mentioned in table no.3 and table no.4 respectively.

Friability

Percentage friability of MCC both grades (HiCel^{TM}90M and HiCel^{TM}XLM90) mentioned in table no.3 and table no.4 respectively.

DISCUSSION

In this experiment, different data generated, indicated that different relative humidity and temperature has effect on the unpacked both grade of HiCel^{TM}90M and HiCel^{TM}XLM90 microcrystalline cellulose, whereas both grades are well stable at all three conditions when packed. As per above data, moisture content of unpacked MCC powder varies with temperature and relative humidity and these variables are affecting the bulk density, hausner ratio, carr's index , angle of repose and the final tablet quality. However, the moisture content of packed material is increasing very quickly until the saturation point is reached, after saturation there are no change in parameters.

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