APTEC Technology Consulting

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Report on Size & Structure of the Poultry Processing Industry in India

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1 Preface - Summarizing the Past Three Reports

We now follow the policy of maintaining four consecutive Reports on our website at all times. When the fifth gets uploaded, the first one gets removed, thus maintaining a total of four. When the fifth Report is being drafted, we will always include a summary of the last four, so that the narrative may seamlessly be available to all.

In the March 15, 2021 Report on the Processing Industry (available for downloading on this website) we had examined the impossibility of accommodating a sufficient number of poultry processing plants within the country for want of suitable sites. This conclusion was reached assuming that all new plants besides the 52 listed in table 1 then, would also imitate the industry of having the same average capacity as existed then, (viz. 2730 BPH).

As a solution to this problem Aptec had proposed the **Hub and Spoke Model**, in which processing activity was to be split into two halves – the **Hub** plants, being fewer in number, located away from inhabited areas and close to good source of water. These would ship fresh chilled whole carcasses to **Spoke** units located close to consumption centers. **Spokes** would portion, pack and ship to retail customers against orders. Since the latter would generate no wastewater, nor would they require heavy investment in capital goods, a single **Hub** plant could cater to many **Spoke** units. **Hubs** being more capital intensive and needing more electrical power, raw water and waste-water treatment, (each of these utilities themselves having high scale sensitivity indices on capital account), would thus become internationally competitive.

Besides a dearth of suitable sites for large scale poultry processing, many of India's regions are water stressed – particularly in the peninsular region. It is encouraging that many very large multipurpose hydrological projects are now under construction to meet the agricultural, drinking and industrial uses in the peninsula region.

Later, in the October 18, 2021 Report, we examined how the industry became internationally uncompetitive at the broiler farming end of the vertical by placing misguided emphasis on self-sufficiency. Indian broiler farming veered in favour of open shed environment, throwing the industry into the arms of a monopoly and foreclosing the choice of newer and more efficient international broiler breeds that continue to be specifically bred for controlled environment farming. It also permanently drove the industry into the cul-de-sac of high operating cost.

The Report then showed how this stalemate could be broken by the government - not just by subsidizing poultry processing and cold chain growth, but by subsidizing expansion of broiler commercial farms to upgrade to environmental control (EC) even to the extent of shutting down all other subsidies, to enable the industry to choose from internationally available breeding stock and break the monopoly.

Then we went on to listing and critically analyzing some bad practices in common use in designing poultry slaughterhouses and processing machinery. In this issue we have added one fresh example.

In this issue of the Report, besides the above, we introduce AptecApp, a new tool available for downloading from our website. This App is expected to help startup processors in planning their ventures properly.

2 Prospects

A number of factors have been in favour of this industry from the last quarter of 2021 when India began emerging from the Covid lockdowns. Over the next 12 month period the situation has only gathered momentum. These factors are:

- The Indian economy is poised for rapid growth over the next several years, thanks to the decline of China as the center of global supply chains and a strong, decisive and stable politico-economic climate in India.

- Covid has sensitized the consumer to the needs for secure and safe food chains. Wet market is no longer in favour.

- The muslim *ashraaf* community that had generally monopolized the wet market through a network of cross-holdings and *benaamis*, sees merit in moving into a more legitimate business environment, namely the organized poultry industry. This follows the community's realization that the 2014 political transition is here to stay. The much-maligned *demonetization* has also played a role in this.

(if you do not understand the three italicized words in my last sentence, google them. There is neither time nor space to explain them here, but they are critical and contextual).

As a consequence I have observed increased background chatter in the industry circles. Many new ventures are planned, but most have not yet made a choice of principal equipment source. There is chatter about some new ventures for local plant vendors too, but these vendors are deliberately uncommunicative about them. So I cannot list them here. I expect that over the next quarter these decisions will be taken by most of them and they will be listed in the March issue of this Report.

3 Size of the Processing Industry, Including History of its Constituents

Table 1 List of Poultry Processing Plants Existing and those Expected on Stream by end of 2023 in India. (This list includes existing units and those based on orders released and/or work already initiated at site).

A	The Organized Sector Comprising Plants of 1000 BPH or Higher Capacities			
	Plant, location	**Make**	**Capacity**	**Remarks**
1	Alchemist Foods & Hospitality Ltd, Kurali, Punjab (Leased to Star Foods)	Meyn	2000	Commissioned in 2004. Since 2017 it is operated by Star Foods under a lease which is to end shortly, with the brand name *Star*. Also leased is the 135 t per month RTE capacity of Alchemist. Within the premises Alchemist operates a manual dressing unit to service web orders for *Republic of Chicken* brand.
2	Al Halal Foods, Thane, Maharashtra	RND	1000	Commissioned in 2016
3	Ambica Chicken, Margao, Goa	Storm	1200	Commissioned in 2016. Suffered financially during the 2020 lock-down, particularly as most of their business was with hotels.
4	AOV Agro Foods Pvt Ltd, Nuh, Haryana. HQ at C-22/25 Sector 57 Noida 201301	Meyn	4000	Promoted by O. P. Arora of AOV Group involved in red meat, who acquired the Nuh facilities from Moin Akhtar Qureshi, one time biggest buffalo meat exporter in India. Commissioned in 2016, modified in 2017 to 2000 BPH. Ordered a 4000 BPH line from Meyn in mid 2021 to replace the existing machines. This last modification was commissioned in 2nd quarter 2022
5	Arambagh Hatcheries. Plant at Birbhum, West Bengal. HQ at 59 B Chowringhee Road, Kolkata https://arambagh.com	Meyn	4000	Commissioned as 1000 BPH in Sept 1999, expanded to 2000 BPH in 2002 and 4000 in 2004. It also produces boneless Kakugiri and Yakitori for the Japanese market and RTE roasted and fried products, sold through its own retail outlets called Arambagh Foodmarts.
6	AV Ventures, Plot Number-72 A, Panchkula Industrial Area Phase 1, Panchkula, Haryana	Storm	1200	Initially operated Nagpal Frozen Foods, Barwala, Haryana, a 1000 BPH plant commissioned by RND in 2007. After its closure on failure to comply with local zoning laws, AV Ventures are setting up a new 1500 BPH poultry & 100 goats per day plant on their own land in Panchkula Industrial area. Work in progress, but there is no news on commissioning date

7	Baramati Agro, Baramati, Maharashtra	RND	1500	Baramati is owned by the family of local politician Sharad Pawar. Their first 300 BPH plant was commissioned around 2002, rebuilt to **750** BPH in 2009 and was now doubled to 1500 BPH in 2020. They also operate a CFS facility for RTE products, producing around 80 t/month.
8	Bharat Agrovet, Plant at Ganjimutt, Mangaluru, Karnataka. HQ behind Annapoorneshwari Building, Mahaveer Circle, Pumpwell, Mangaluru, Karnataka.	RND –Storm	1500	Old plant of Lifeline Feeds built by RND was reconditioned and reinstalled by Storm Eng in Nov 2015.
9	Charoen Pokphand India Pvt Ltd (CP). Plant at Chittoor, Andhra Pradesh. HQ at CPF Tower, 1, 100-Feet Road, Stage 2, Hoysala Nagar, Indiranagar, Bengaluru, Karnataka https://cpbrandindia.com	Meyn	2000	Commissioned in January 2016. It is the only air-chilling plant in India. Planned expansion went into abeyance for lack of space. Also get contract processing done by Penn Foods, ProTAC. RTE sold as *Five Star Chicken* – read about it in part B of this table
10	Coastal Farms, Plant at Kannur, Mangalore, Karnataka. HQ near Navdurga Bus Garage, Mangalore, Karnataka	Marel	2000	Partnership started in 1996 by P. S. Prakash Shetty and his wife. Initially had a drum plucking plant from RND, serving six retail outlets in Mangalore. Construction started in 2017. Four years later, in 2021, it was finally Commissioned.
11	Godrej Tyson Foods. Plant at Taloja, Maharashtra https://www.godrejagrovet.com/godrej-tyson-foods	Marel	3000	Expanded from original 2000 BPH of 2001 to 3000 BPH from original set up in an industrial estate around 2017.
12	Godrej Tyson Foods. Plant at Hoskote, Karnataka https://www.godrejagrovet.com/godrej-tyson-foods	Marel	3000	Set up in 1999 as 1000 BPH RND plant which was scrapped in 2007. The 2000 BPH Marel plant was set up in an adjacent plot of land in 2007. Expanded in 2012. In 2008 Godrej tied up with Tyson. Their brand is *Real Good* . They also produce RTE products on 400Kg/hour used line sourced from The Waterbase of Nellore, a failed fish RTE unit. Since this plant is in a smart city zone, it is now under pressure to relocate.
13	Goel Foodworld, Plot no 23A, Industrial Area, Shogi, Shimla, Himachal Pradesh	Storm	3000	This is a replacement of the existing 500 BPH plant by Dhopeshwar commissioned over a decade ago. The modified plant has been installed in 2020 by Storm Engg. Expanded to 3000. Under pressure to relocate out of city limits according to zoning laws A piece of land has already been purchased by them.
14	Goldchick Hatcheries and Foods Ltd. Plant at Sadashivpet near Hyderabad, Telangana. HQ at Plot No.151, Kavuri Hills, Madhapur, Hyderabad, Telangana http://goldchick.in	Marel	2000	Commissioned in Sept 1998, and in intermittent operation since then. First to export Indian processed chicken and also the first in the world to install an automatic re-hanging machine at this low capacity.
15	Golden Hatcheries Pvt Ltd, Plant at Davangere, Karnataka. HQ at Golden Hatcheries Building #3, Queen's Road Cross near Congress Committee office, Bangalore	Meyn	3000	Part of the Golden Group companies started in 1985 and incorporated three years later. Placed order on Meyn in Feb 21 for setting up a green field unit close to Venkys in Davangere. Installation is under progress now and commissioning may happen by first quarter 2023.
16	Healthy Choice Poultry, village and post Wadala, Tehsil Majitha, Distt Amritsar	Meyn	1300	Plant owned by Gurpuran Singh Randhawa. To be commissioned in first quarter of 2023

17	Huda Foods Pvt Ltd. Plant at Kondhwa. HQ at FL-I-403 Unity Park, SN-43 Kondhwa Kd, behind Sheetal Petrol Pump, Pune	Deccan	1500	Incorporated in 2020 by Sarfraz Momin. The plant processes birds procured from the Japfa farms.
18	Hybro Foods Pvt Ltd. Plant at Lahe, Taluka Shahpur, District Thane, Maharashtra. HQ at 8, Shah Industrial Estate, Opposite Veera Desai Road, Andheri West, Mumbai	RND	3000	Installed in 2004 as a 1800 BPH plant, then expanded to 3000 BPH.
19	Japfa Comfeeds Pvt Ltd, 91 Sakore Nagar Vimannagar, Pune 411014, India https://japfaindia.com/	Marel	3000	Work has commenced constructing a 3000/6000 BPH plant at Village Pedgaon, Tal Daund, Distt Pune in Maharashtra. The plant is expected to be commissioned by end 2023. Meanwhile the company continues to sell chicken processed at the leased plant of Maval Agro at Talegaon.
20	Kuljas Rai Poultry, Amritsar	Storm	3000	Kuljas Rai Poultry set up a **300** BPH Dhopeshwar plant at Chamrang Road, Amritsar, Punjab. Under orders to exit municipal limits, they closed down this plant and put it up for sale. Rai's new Storm plant near Amritsar, is in operation from first quarter 2020. Also make RTE poultry products to cater to local markets.
21	KGN Poultry, Pimpri, Maharashtra	Storm	1500	Started as a manual plant of 300 BPH. Storm plant was commissioned in 2018.
22	Kavi Proteins, Krishnagiri, Karnataka HQ 26, 1st Cross, Sindhi Colony, behind VISL House, JC Road, Bengaluru	Storm	1000	Operating at 700 BPH. Suffered closure with the onset of the lock-down. Shreya Farms is operating it now.
23	Khazir Agro. Plant I.G.C. Lassipora, Srinagar, Srinagar U.T. HQ 4th Floor, Opp New Era School, Rai Bagh, Srinagar, Srinagar U.T.	RND	1000	Production commenced in January 2021. Production is irregular.
24	Kwality Animal Feeds Pvt Ltd. Plant 763/19, A/P-Rajgoli, Chandgad, District Kolhapur, Maharashtra. HQ 12, Kwality House Machhe, Industrial Area, Belgaum, Karnataka http://kwalityhouse.in/	Meyn	3000	Ordered as a 2000 BPH plant in Dec 2014. Commissioned in June 2016. Expanded to 3000 end 2018. Sell under the brand name *Belchick*.
25	Lifeline Feeds (India) Pvt Ltd. HQ at Shri Manjunatha Chambers, Ratnagiri Road, Chikmagalur, Karnataka. Plant at nearby industrial estate in 8 acres occupying four adjacent industrial plots separated by 3 roads. https://www.lifelinefeeds.com	Meyn	3000	300 BPH RND plant commissioned in 2002; sold to Amrit Feeds and replaced by 1900 BPH RND plant around 2005. Again replaced by a Meyn 3000 BPH plant in June 2015. Sell through 40 company owned retail outlets in Karnataka. Owned by K. Kishore Kumar Hegde.
26	Mayuri Broiler Breeding Farms Pvt Ltd at Sy 537/A, 537/E, Village Yellikal, Kalwakurthy, Nagarkurnool District, near Hyderabad	Storm	1000	Mayuri Farms, owned by Harsha Poultry, operate a manual dressing plant of 400 BPH in Telangana, Their 1000 BPH plant was commissioned earlier this year.
27	Miki Exports International, Taloja, Maharashtra Domain name http://mikichicken.com has expired.	RND	2000	Established in 1950 as Miki Food Stuffs, for export of frozen buffalo meat from a plant at Muzaffarnagar, U.P. In 2015 they commissioned this plant. It was shut down during the lock-down. The facility now processes for Fresh To Home and Licious. It is not clear whether this facility has been sold or leased.
28	Nafees Poultry Plot No 129, East Marredpally, Hyderabad 500026, Near Delhi Public School, Shanthi Niketan Society, Mahindra Hills, Hyderabad.	RND	1000	Operated by Sarabjyot Singh, son-in-law of Harbans Singh, one time owner of Starchick (see Sethwala). This plant started around 2013.
29	Penn Foods Pvt Ltd. Plant at Karjat, Maharashtra. HQ at Clucky's Products LLP, 294, S. Bhagat Singh Road, Fort, Mumbai http://cluckys.co/the-processing-plant/	Bayle	1500	Commissioned in 2016. Contract processing for CP, McDonald and Licious. Also selling through Amazon, Metro Cash and Carry, Walmart and others. Brand name is *Clucky's*.

30	Perfect Poultry Pvt Ltd. Plant and HQ at 27 Ft Road, Chowk Green Field, Majitha Road, Amritsar, Punjab.	Meyn	4000	Commissioned at 1000 BPH in July 2015 by Storm Engineering. Has been replaced by Meyn's 4000 BPH plant which was. commissioned in December 2021.
31	Premium Chick Feeds	Storm Eng.	1500	Construction in Raigad district commenced in early 2022 after Maval Agro, which they had been using earlier was snapped up by Japfa. Expect commissioning by mid 2023
32	ProTAC Foods International Pvt Ltd, Plant and HQ at 115 Allalasandra, behind RTO Check Post, NH4, Mulbagal Taluk, Karnataka	Meyn	4000	Commissioned in June 2016. Planned as a merchant processor with *mandi* sourced live birds. Operating on contract at 35,000 BPD for Tri Star (Kerala), Nandus, Licious, Shanti (Fortune), Fresh to Home and CP. Plan expansion to 4000 BPH to meet growing merchant processing demand. The expanded capacity will be in operation in first quarter of 2023
33	RFK Greens Pvt Ltd. Plant at Lassipora, Pulwama, J&K. HQ at C-37, First Floor NSM, Azadpur New Delhi	Meyn	2500	Ordered end July, 2017. All utilities and services commissioned. Expect to commission the plant in Dec 2022.
34	RM Delicious Foods, Khatoni No 102, Khewat No 92, VPO Seenk, near Bus Stand Tehsil Israna, Panipat, Haryana 132103,	Meyn	1300	Owned by R Malik as part of his Part of RM Agro Group of Companies. Plant expected to be commissioned in end 2022.
35	Royal Foods/Ave Miriam, plant at Salsette, Goa. HQ at Mario Valladares, 142/2, Near Metastrip, Nauta, Cortalim, Goa	RND	1500	Originally 500 BPH. Expanded in 2009 to 1000 BPH, later again to 1500 BPH. Suffered losses during the lock-down. Now resumed operations in a limited way.
36	Sabir Qureshi (formerly Sneha Farms)	RND	1000	Mohd Sabir Qureshi, one time employee of Phoenix Poultry, bought the 2011 RND plant of Sneha Farms, relocated and re-commissioned it at Jabalpur in 2019.
37	Sethwala Foods Pvt Ltd, plant at Talasari, Palghar, Maharashtra.	Marel/RND/Storm	2000	Installed a refurbished 500 BPH used Stork plant originally sold to Shiraz Hotels, Agra, then to Harbans Singh of Starchick, Hyderabad, who in turn sold it to Hanifbhai of Sharon Broilers, who in turn sold it to Sethwala in 2012. Installed by Dhopeshwar shortly thereafter; expanded and re-commissioned with inputs from RND and Storm. The brand name is *Seth's*
38	Shalimar Corporation, Plant at Galsi, Panagarh, West Bengal. HQ 17A, B & C Everest, 46C Chowringhee Road, Kolkata http://shalimarcorp.in	Meyn	6000	Commissioned in Sept 2014 at 2000 BPH. Expanded to 2600 in 2018. They now plan to expand to 6000 BPH by first quarter of 2023. They sell under the brand name *Total Chicken*. They have plans to expand in other parts of the country- the first to be in the northern zone.
39	Shanthi Feeds. Plant at Dindigul, Tamil Nadu. HQ village Pappampatti, Coimbatore http://shanthifeeds.com	Meyn	12000	Originally a 1000 BPH Meyn plant commissioned in 2009. Expanded in 2 stages to 3000 BPH till 2014. Then expanded and re-commissioned at 6000 BPH in Feb 2016. Expanded to 12000 BPH in first quarter of 2021.
40	Sivasakthi Agro Foods, plant at Udumalpet, Tamil Nadu. HQ 793/18, Kumaralingam West Village, Rudrapalayam Post, Madathukalam Taluk, Tirupur Dist. Tamil Nadu http://www.sivasakthifoods.com	Marel	5000	Originally planned as a 1000 BPH facility in mid 2012. Changed to 2000 BPH in 2013 and came into production in early 2016. Expansion to 3000 BPH commenced in May 2019. Last year they had expanded to the present capacity. Brand name is *Suprieya*
41	Skylark Foods, plant at Rai Food Park, Sonepat, Haryana. HQ at Dharamgarh	Meyn	1000	Commissioned March 2006 on an 1800 SqM piece of food park land with no room for expansion or growth. They have

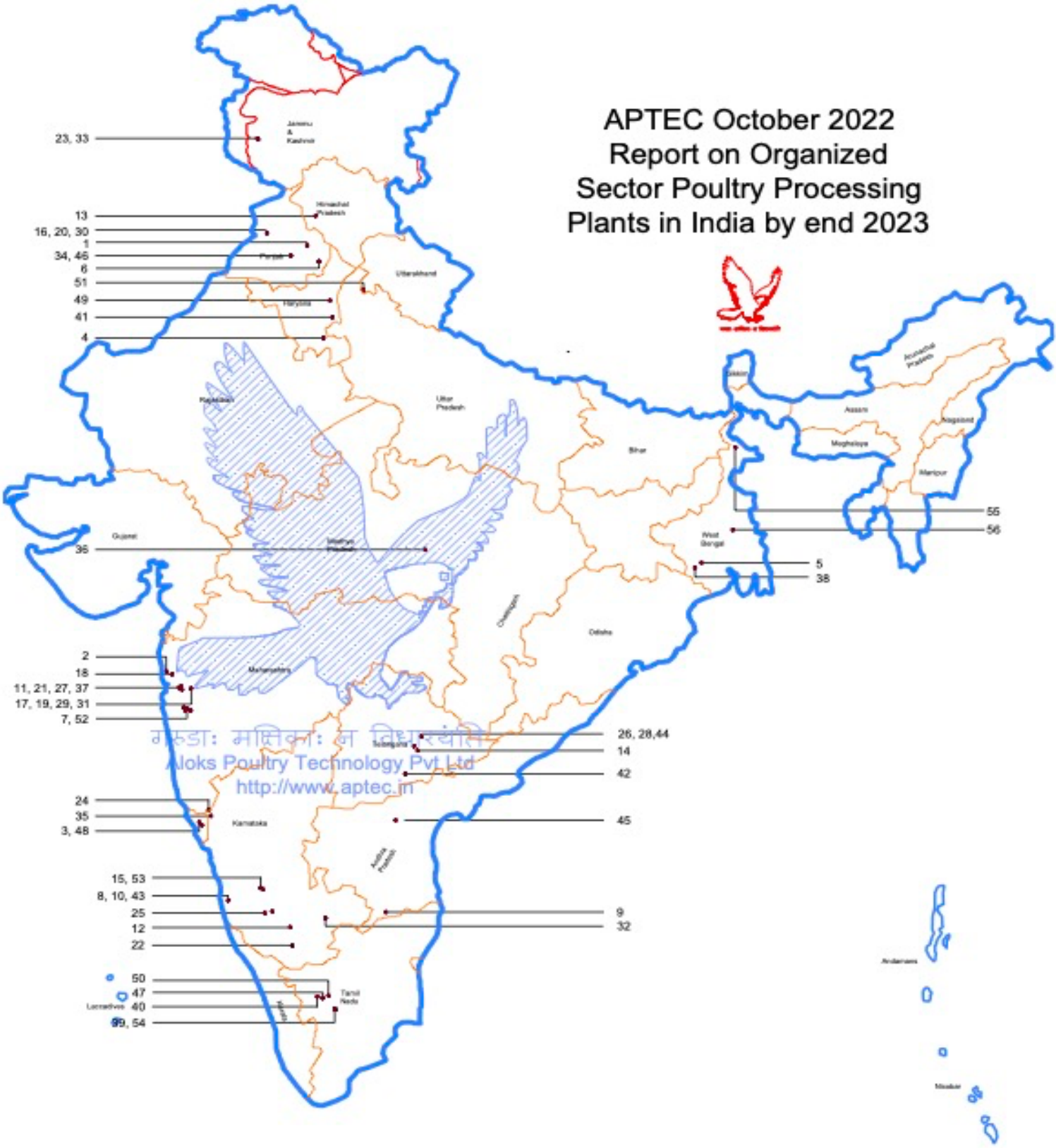
	Road, Safidon, Distt. Jind, Haryana http://skylarkfoods.com			added an RTE plant in a nearby plot of land. Sell through Walmart, Nirula's, and to many premium hotels and their franchisee outlets. Brand is *Nutrich*.
42	Sneha Farms Pvt Ltd, plant at Addakul, Hyderabad-Bangalore Highway, Telangana. HQ at Plot No 30, Survey No. 22, 17AA, Kondapur, Hyderabad http://snehagroup.co	Marel/Meyn	12000	Ordered initial 6000 BPH plant from Marel in March 2014. Commissioned in April 2016. Procured equipment from Meyn for doubling their capacity. Commissioned in end 2021.
43	Souza Hatcheries, Mangalore, Karnataka. HQ at Souza Commercial Complex, Highlands, Falnir Road, Mangalore http://www.souzahatch.com	Bayle	1000	Commissioned 2013 for Lester D'Souza. Fate of RND plant of 500 BPH bought earlier by them is yet not known. Ideal chicken operates this facility now.
44	Srinivasa Farms Private Limited, plant at Taniki Village, Kowdipally Mandal, Medak District, Andhra Pradesh. HQ at 169, Road 13A, Jubilee Hills, Hyderabad. https://www.srinivasafarms.com	Bayle	1000	Ordered May 2015. Commissioned in Sept 2017. Operating at 1500 BPH. In a plant audit done by me last year, I advised operation as a Spoke facility, with additional whole carcasses from their Prakasam plant awaiting commissioning.
45	Srinivasa Farms Private Limited. Plant at Mega Food Park, Kurichedu, Prakasam, AP. HQ at 169, Road 13A, Jubilee Hills, Hyderabad. https://www.srinivasafarms.com	Marel	2000	Order for the 2000 BPH plant was placed in late 2017. The plant is installed but commissioning is delayed. Individual pieces of equipment are learnt to have been sold.
46	Star Foods Pvt Ltd, proposed plant at Ladhowal Food Park, Ludhiana. HQ at Sampoorna Feeds, Phagwara, Punjab http://sampoornafeeds.com	-	4000	Land procured. Plans ready. Plant supplier not yet chosen. Implementation expected to be delayed due to the sudden death of the promoter Mr Ashish Gupta in August 2021. Work recommenced in February 2022 but stopped again shortly thereafter.
47	Suguna Foods Pvt Ltd, Vyalur, Tamil Nadu HQ at Unitea Building, No 3, Savithri Shanmugam Road, Race Course, Coimbatore. https://www.sugunafoods.co.in	Meyn	3000	Commissioned 2000 BPH in Aug 2002. Grew in 2009. Due for revamping. Suguna acquired processing plants in other zones – Alpha Agro (west) and SHL Foods (north).
48	Suguna Foods Pvt Ltd acquisition of Alpha Agro & Cold Storage Pvt Ltd), Belgaum, Karnataka	Meyn	1000	Commissioned in April, 2014, as a Meyn 1000 BPH plant to function as a merchant processor mainly for the armed forces, Goa and local markets. The company was purchased by Suguna in 2019.
49	Suguna Foods Pvt Ltd acquisition of SHL Foods Private Ltd (Sagri) Plant at Lalru, Punjab.	Meyn	2500	Originally a 1000 BPH plant set up in 2009 at Chanalon Industrial Park, on a mere 1000 SqM plot of land by Surjit S. Kohli. Relocated, expanded, re-commissioned in Feb 2014. Sold in 2018 to Suguna.
50	Swami Feeds. Plant at Dharapuram. HQ SF 324/2C Nathapalayam, Mulanur, Dharmapuri, Tamil Nadu	Marel	3000	During construction parts of the structure were gutted in a fire. Came on stream in mid 2021.
51	Syra Foods. (Redifining Taste) W-8/L, Industrial Area, Yamunanagar, 135001, Haryana, India.	Linco	2500	Ran into local resistance successively at two proposed plant sites. Are now looking for a third site. Equipment has been ordered and expected to arrive at site in the first quarter of 2023.
52	Venkateshwara (VH) Plant at Kamshet near Pune. HQ Venkateshwara House, 114/A/2, Pune-Sinhagad Road, Vitthalwadi, Pune. http://venkys.com	Meyn/ Marel	3000	Commissioned in 1986 as 1000 BPH Meyn plant – the first processing plant in the private sector. Expanded to 3000 BPH by Marel during the early 1990's. Old Marel equipment progressively replaced by Meyn's Walvekar consignment.
53	Venkateshwara. Plant at Davangere, Karnataka. HQ Venkateshwara House, 114/A/2, Pune-Sinhagad Road, Vitthalwadi, Pune. http://venkys.com	Linco	6000	Commissioned in March 2012. Since the commissioning of this unit they have preferred to focus on RTE instead of primary processing. VH has large RTE facilities at both locations.

54	SKM Feeds (earlier known as VKS Farms). Plant at Dindigul, Tamil Nadu. HQ Nanjai Uthukuli, Modakurichi Tamil Nadu https://www.skmpornafoods.com	Meyn	8000	Original capacity of 2000 BPH commissioned in Sept 2009 by VKS. Company changed hands in Jan 2015 and became SKM. Expansion to 4000 BPH done by mid 2019. Further expansion to 8000 BPH was commissioned in 3rd quarter 2022.
55	West Bengal Livestock Dev Corp, Haringhata.	RND/Storm	1000	Commissioned in 2015.
56	West Bengal Livestock Dev Corp, Siliguri	Linco	1000	Combined poultry, goat, beef and pork slaughterhouse expected to commission soon.
Integrated processing capacity expected by mid 2022 based on current orders, on-stream and under-construction projects			**1,54,000**	**Average plant capacity is 2750 BPH.**
Capacities are mentioned in birds per hour. For calculating market shares, of the total capacity of 1,50,000 (1,54,000-4000 of Star) BPH expected on stream by end 2023, Meyn's market share is 75,100 (50.1%), Marel's is 31,000 (20.7%), Storm Engineering's is 15,400 (10.3%); RND's is 14,000 (9.3%), Linco's is 9,500 (6.3%), Bayle's is 3,500 (2.3%); Deccan's is 1,500 (1.0%). [Total 1,50,000 (100%)] [Sethwala's capacity divided >> 500 to Marel, balance 750 each to RND and Storm Engg]				
Proposed project of Anjaneya has been dropped from the table because of ongoing uncertainties.				
B	This Table lists (1) small un-organized sector processing plants with manual dressing, drum plucking and conveyorized or partially conveyorized poultry processing plants with capacities under 1000 BPH (2) closed and scrapped poultry processing plants of all sizes – many of which were re-sold and subsequently grew to become organized sector processing houses- at which time they cease to be listed in this section, (3) RTE plants who source chicken meat from processing plants, and even if their repertoire only marginally includes chicken, they have the machinery, experience and general potential to follow market trends and become noteworthy for poultry processors (4) Web based poultry and poultry based RTE order suppliers, many of which are acquiring idle facilities and reviving them or setting up *cloud kitchens* for captive use. Also, while compiling this list I have dwelled on historical past of potential big players in the processed food and QSR sectors in the belief that history is a great teacher and may eventually direct their steps towards this industry. Plants possessing RTE capacities are indicated with underlined capacity figures.			
57	**Agritech Hatcheries Ltd** promoted by Damania brothers, started with a 1000 BPH Meyn plant in early 1990's at Ahmadnagar, Maharashtra. It then expanded in 1995 to 4500 BPH and at that time was the most advanced facility in India. It then closed when the group became insolvent around 1997. Leased for a year from the State Bank of India by C&M with a view to re-commission it, they failed and surrendered it in 1999. Later the plant was scrapped.			
58	**Al Arif Poultry**, Vakwady Road , Udupi District, Karnataka. Operate a **700** BPH manual dressing plant.			
59	**Al Kabeer** Group has been in processed foods in the Middle East since 1978, establishing a unit in India with a processing facility in Hyderabad, Cascade Marine Foods in Sharjah and Falcon Foods in the U.K. In Hyderabad it produces, besides other products, RTE items with chicken sourced from nearby processors. http://www.al-Kabeer.in			
60	**Amalgam Group**, Cochin, Kerala (Innovative Foods – Sumeru brand) was started in 1977 as a family owned seafood and spice exporting company. Later in 1989 they diversified into processed foods – partnering with Nissin Foods of Japan for freeze drying and with Mitsubishi and Unilever to develop cold chains, besides Ristic GmbH, Saudi Fisheries and others, consolidating their business around Innovative Foods, a clearing and forwarding agency for Hindustan Lever ice cream. Headquartered at Bangalore. Their first attention was to frozen vegetables, followed by *parathas* and finally to RTE chicken based products under the 'Buffet' range, offering sausages, nuggets and popcorns, *samosas*, spring rolls and burger patties in chicken and pork. Production is distributed between two plants – at Cochin and Chittoor where they have breading, battering, frying, IQF and soup making machinery. Lacking a primary processing plant, they source chicken and pork from nearby processors, which amounted, last year, to INR 60 million. Recently they launched innovative recipes curated by Michelin Star Chef Alfred Prasad and now propose to venture into vegetarian and meat based momos. http://www.sumeru.net			
61	**Amrit Feeds**, Jangalpur, Howrah, West Bengal, bought original RND plants from Lifeline Feeds and Ave Mariam and installed the combination as a 300 BPH unit at Jangalpur. Later expanded to **700** BPH in 2009. Along with this primary processing facility they also set up a sausage and ham plant in 2010 with an investment of around INR 30 million for sale under the brand name *Fresco Pollo*. Now closed. Planned relocation of this plant to Assam in 2016 was dropped. http://www.amritgroup.net.			
62	**Amrit Feeds**, Beldanga Mouza, Raghunathpur, PO Bonkati KanksaI Panagarh, West Bengal. A Linco plant of 4000 BPH plant commissioned in first quarter 2014 and promptly closed on June 1, 2015. Available for sale but unlikely to find buyers because the asking price is too high. http://www.amritgroup.net.			
63	**Arthur's Food Company**, Bangalore. This RTE plant retails through Big Basket, Food Basket, Foodhall, Foodworld, Metro Cash & Carry, Nature's Basket, Scootsy, Spar, Spencer's and Star Bazar. http://www.arthursfood.com			
64	**AOV** old plant with **2000** BPH machinery from both RND and Storm may be on sale after commissioning of the Meyn plant			
65	**Barafwala Co**, 11 High Street, Camp, Belgaum, Karnataka. Had so far been confined to the red meat industry. Recently they have set up a pilot plant for processing poultry using some Deccan Automation Technology machines and some made by themselves and are slaughtering 2000-3000 birds daily.			
66	**Brahmagiri Dev Society**, Wynad, Kerala, **500** BPH by RND in 2010.			
67	**Broiler Master**, Punjab, **200** BPH by RND in 2011. This is a "dry processing" plant, having neither scalding nor plucking and does wet market style evisceration.			

68	**Caris Pure** Processing Company Pvt Ltd. Plant at Paramankeni Village, Kancheepuram, Tamil Nadu. HQ at 23 C, Kohinoor Complex, East Coast Road, Village Vettuvankeni, Injambakkam, Chennai, Tamil Nadu. Tae-Jin supplied the **3000** BPH plant which is now closed and available for sale. Promoted by one Prince Jacob, an NRI from Korea and Madavan Nair in May 2013. Operated for some time by a hotel chain. Purchase bid by Suguna, Shanthi and others failed to get transfer of local PCB approval to any new owner. In Nov 2019 the banker issued an auction notice. The promoters were charged with non-payment of GST, which is mandatory for organized sector processors but not levied on the wet market[1]
69	**Central Avian Research Institute**, (IVRI) Bareilly, **200** BPH by Dhopeshwar.
70	**Century Farms**, Manipal, **500** BPH plant built by Storm Engineering, in operation from 2015
71	**Chatha Foods**, launched by P.S. Chatha in 1998 at village Chaundheri, Dapper, on the Chandigarh - Ambala highway in the Mohali district of Punjab, market their RTE products under the brand names *Gustto* and *Swiss Naturen.* With their retort packaged products being shelf-stable at ambient temperature, they beat the hurdle of the inadequate cold chain. They source chicken meat from SHL Agro and Shanthi. Their institutional customers include about 80 five star hotels besides Taj Air Caterers, Sugar and Spice and ITC Welcomegroup. They also retail through some 1100 outlets http://cfpl.net.in
72	**Coastal Hatcheries**, Mangalore, **500** BPH by RND. To be scrapped now that their Marel plant is commissioned.
73	**College of Vet** & Animal Sciences, Kerala, **200** BPH by RND in 2003.
74	**Contai Golden Hatcheries** Pvt. Ltd, Contai, E. Midinapore, West Bengal, **300** BPH by RND in 2003. It is owned by Shalimar Hatcheries and is available for sale.
75	**CP India**, Chennai, 500 BPH by RND in 2002. Scrapped soon after commissioning.
76	Computerized web based delivery platforms for order booking and order tracking using purpose-designed apps. These include **Amazon**, **Food Panda**, **Fresh to Home**, **Licious**, **Ola**, Road Runners, **Swiggy**, **Zapp Fresh**, **Zomato** and others
77	**Darshan Foods** or ***Meatzza***. Established in 1969 as a buffalo meat exporter. Started an RTE division in 1996 with facilities for delicatessens, Indian products like *seekh kabab*, *shami kabab*, *samosa*, *tikka* etc. and breaded products for retail & institutional customers. Now operate through their own plant at Lawrence Road Delhi, several leased premises at Udyog Vihar, Gurgaon and a purpose-built plant at Behror, in Rajasthan. It has a combined capacity of 750 tonnes per month from Chicken, Pork & Mutton/Lamb. It sources whole dressed birds from many plants listed in Section A of this table as well as from Ghazipur *Mandi.* Possesses a Meyn cone de-boner line for portioning and deboning chicken carcasses. The company is run by Narinder and Rajiv Jaisinghani. http://www.meatzza.com.
78	**Doon Valley Poultry**'s **500** BPH plant supplied by Storm Engg. Commissioning expected in first quarter of 2022.
79	**Dr Srinivasa**, promoter of the debunked 500 BPH Bayle plant called Pragathi Broilers at Doddballapur, is planning another facility in Karnataka, this time of 1000 BPH.
80	**Empire Foods**, Taloja, Maharashtra. **1000** BPH plant purchased from RND some 8 years ago, not yet installed. It has probably been resold to and installed by another company, or listed here under a different name.
81	**Farm Suzanne**, 64, Montieth Road, Egmore, Chennai 600008, Tamil Nadu. Established in 1984 by Eric and Mary Rodriguez at Siruseri, near Chennai with a capacity of 1.5 tonnes per day, as a branch of a larger sea-foods company. They sell to institutions and retail chains and also performs as ship chandlers. Procure chicken meat from several processors listed in Table 6A. They partnered with Pizza Hut to make pepperoni for the first time when the Indian Government banned its import in 2006. In 2015 they were planning a new plant. http://www.farmsuzanne.com
82	**Farm Value** Foods Private Limited owned by Anshu Sibbal Chatli runs an RND plant of **350** BPH capacity at Barnala, which was commissioned in 2014.
83	**Five Star Chicken**, a unit of CP, acquired in 2005 and brought to India in 2012 with in-house production of RTE fried chicken products for sale through franchise outlets to cater to a QSR market, then valued in 2016 at INR 60 billion. They opened some 350 outlets across states like Andhra Pradesh, Goa, Karnataka, Kerala, Tamil Nadu and Telangana and cities like Bangalore, Hyderabad, Mumbai and Pune within 2-3 years. They also used delivery websites of Food Panda, Ola, Road Runners, Swiggy and Zomato. Chicken was initially sourced from a small processor in Bangalore, to be cooked at a pilot facility in Hoskote, later, commencing 2016, from their 2000 BPH Meyn processing plant at Chittoor where they also have an RTE plant. In 2016 they shut 133 non-performing outlet, because of sluggish market growth, bringing their total down to around 270 today. However CP's lease of Penn Foods in Maharashtra and use of ProTAC contract-processing indicates their continued drive in this market. https://www.fivestarchicken.com
84	**Food and Flavours**, Bangalore. Produces dehydrated chicken meat with raw meat sourced from Godrej, Hoskote. The facility has a 3 tonne per day dehydrating capacity which it divides between vegetables and chicken meat for customers like Indo Nissin Foods, Bangalore; International Bestfoods, Mumbai; Arinor, London; CPC Agrifoods, Colombo & CPC/AJI, Malaysia. Nissin Foods in turn was formed by a partnership between Itochu Corporation of Japan and Sumeru, part of the Amalgam Group to establish India's first freeze drying facility to produce food ingredients.
85	**Gitwako Farms**, headquartered at Jangpura Extension, New Delhi, is owned by Ajay Beri at Ferozepur Jirka. They operate an RND plant of **unknown** capacity and also process goat meat. Mainly produce RTE products for which they possess a retort.
86	**Godrej Tyson**, Hoskote, Karnataka, 1000 BPH by RND in 1999, (scrapped in 2007, replaced by a Marel 2000 BPH plant, which was later expanded to 3000 BPH). They have a 400 Kg/hour formed products line and a sausage, salami and cold cuts line – part of which was reconditioned and procured from The Waterbase Nellore facility of the Ballarpur group – a fish further processing facility that failed.
87	**Golden Hatcheries** Bangalore, operate a manual dressing facility of **500** BPH within municipal limits. Under orders to relocate. Setting up a 3000 BPH Meyn plant at Davangere.
88	**Hayagreeva Poultry** Solution has a **500** BPH RND plant located at Doddaballapur near Bangalore which was commissioned in 2020. The plant was earlier owned by Chicken Stop, sold to another owner, then shifted to its present location.
89	**Hitech Hatch** Fresh, Kolkata. Already have a manual dressing plant of **unknown** capacity and plan to set up a modern processing unit soon.

90	**Higrow Chicken**, owned by Deepak Raj Garg, runs an RND plant of **500** BPH at Ludhiana, which was commissioned in 2017.
91	**Hygienic Chickens**, 356, Akal Market, Chaura Bazaar, Ludhiana, Punjab, **300** BPH by RND.
92	**Ideal Chicken** (Anupama Feeds and Farms), Kulshekar, Mangalore, run by Vincent Cutinha. Commenced processing around 2017 with a locally sourced plant of **unknown** capacity which runs its own home delivery and also process for Fresh-To-Home and Licious http://www.idealchicken.in
93	**Indian Broilers** (IB Group, Rajnandgaon) located at Nagpur, Madhya Pradesh. It is a **500** BPH plant by RND, started in 2016.
94	**Indian Hospitality** Company Group was registered in Caymen Islands in 2006 to make investments in hospitality and QSR sectors. To help them do so, they recruited the founder of Barista and CEO of Yum and acquired Adelie Foods of UK, who are contract caterers and suppliers to airlines, in 2012. Subsequently they acquired Skygourmet, Mars Restaurant chain, Birdy's, Dosa Diner, Roti, Pizzeria & Pasta Bar, and Tendulkar's. Owing to these, IHC is now fully into QSR and RTE foods businesses, and given the market potential, may make an entry into the chicken RTE sector.
95	**International Food Products**, Chandigarh. Small RTE producer in chicken and other meats.
96	**Irani Chicken** Products LLB, Daman, Gujarat, **500** BPH plant by Bayle, commissioned Dec, 2013.
97	**ITC Welcomegroup** made its entry into the branded & packaged foods business in August 2001 with inspiration from its successful restaurants Bukhara and Dum Pukht. In June 2003 they launched their *Kitchens of India* brand comprising a range of heat-and-eat Aashirvaad brand RTE meals. This range was available in heat-resistant packaging form, produced using a retort process at Chatha Foods. Their Indian meal packs are sold in Australia, Canada, Germany, Japan, New Zealand, South Korea and USA. Although this range contributed only 1% of group sales, it sold 6 times as much in USA than in India in 2012 and was the second most sold Indian meal in USA after *Tasty Bites*. It set up a new plant for these product lines at Bangalore.
98	**Knowledge Foods**, Neral. Manual-dressing **300** BPH. Also making RTE products.
99	**KSIDC**, Kerala, **300** BPH by RND in 2005.
100	**McDonalds India**, now owned by OSI, set up their first plants at Taloja in the 1995 as Vista Foods and Kitran Foods to cater separately to vegetarian and non-vegetarian products. Recently they set up a vegetarian products facility in Punjab and acquired the facility of Global Nutri Foods Ltd at Madanapalle in AP. Altogether they possess an RTE capacity of 625t/m at Taloja and 1750t/m at Madanapalle. They source approximately 95% of their supplies from 38 local sources – raw chicken coming from the Godrej Taloja plant. Are now installing a cone de-boner sourced from Meyn. https://vistafood.com
101	**MTR**. Started in 1924 as a restaurant called Brahmanara Coffee Club and later in 1951, changed to Mavalli Tiffin Room in Bangalore. During the Emergency, unable to conform to the prescribed pricing orders of Indira Gandhi, they diversified into packaged convenience foods. Around 2008 they were acquired by Norway's Orkla Foods. They produce seasonings, RTE foods, curries and RTE meals. In 2012 the original owner P.S. Maiya, no longer encumbered by the agreement with Orkla, re-entered the RTE foods segment with a new company. Given the dynamism of Maiya and Orkla, they are both quite likely to enter the RTE chicken sector, given its growth potential.
102	**Maval Agro**, Chakan Road, Talegaon, Maharashtra. A **700** BPH merchant processing plant built by an ex-employee of Deccan Automation (who later set up his own brand of poultry processing machinery under the name of Deccan Automation). Was in use by Premium Chicken of Raigarh since 2015. It shut during the lock-down. Now after being revamped, it is run by Japfa India for continued trial marketing pending completion of their own plant.
103	**Meat Masters**. Incorporated in 2000, a producer & supplier of frozen vegetarian & non-vegetarian (fish, mutton and chicken) and RTE products in retort pouches and filled products like sausages. They have set up a new processing facility for further processed meat products at Ladhowal Food Park near Ludhiana in Punjab. Meat Masters sells through own stores BigNMeat, other retailers, and directly to hotels and restaurants in that region http://www.meatmasters.co.in.
104	**Meat Products of India**, a Kerala government company established in 1973, operating in Chalakudy and Edayar, with bought-out chicken meat and pork from own farms. Produce feed and RTE products. Accumulated losses exceed 3 years' turnover.
105	**MP Pashudhan Nigam**, Bhopal, **500** BPH by RND in 1997. Scrapped. When newly commissioned, this plant inspired Dr Anaokar, then MD of Godrej Agrovet, to model his Hoskote unit on it.
106	**Monrovia Foods**, Bhandgaon, Pune, Maharashtra, **500** BPH by Storm Engg in Jan 2014.
107	**Nagpal Frozen Foods**, Barwala, Haryana, 1000 BPH plant commissioned by RND in 2007 and operated by Nagpal's relative Mulk Raj and his sons under the name of Chandigarh Poultry, suppliers to the armed forces. Chandigarh Poultry was later renamed AV Ventures. Nagpal Frozen was closed in 2017 for non-compliance with pollution control laws and has probably been scrapped. Following this, AV Ventures decided to set up their own plant in Panchkula. It is listed in table 1, part A.
108	**Navi Nutrix**, **750** BPH by RND at Kaveripatnam, Krishnagiri in Tamil Nadu, commissioned end 2017. Now suspended operations and leased to Shreya Foods
109	**Nandus Foods** Pvt Ltd. Headquartered at Bangalore, the Nanda Group, comprises 11 small companies promoted by P. S. Nandakumar, an old business associate of Rao of VH. As integrators, Nandus skipped the processing stage, venturing directly into RTE in 1989 with a 400mm Koppens forming-frying line and a 32 tonne frozen store. They initially ran it themselves, and at one stage even fought and lost a legal battle in 2007 with the international restaurant chain Nandos Indage Restaurants P. Ltd over brand ownership. The RTE line was leased to Suguna in 2007 for a five year period. At the turn of the century they acquired a small Linco slaughterhouse, which had been closed down and mothballed for sometime by its previous owners in UAE, in collaboration with Godrej Agrovet and Sheikh Hamed bin Butti under the name of Al Rahba. Around 2015 they turned their attention to processing with a used RND line in Karnataka. Now closed. Planned a 2000 BPH processing plant, placing an order with Marel. Finally abandoned the project to work instead as a Spoke facility in Bangalore, integrating it with their existing RTE kitchen. They get 6000 birds from their farms contract-processed every day by ProTAC and distribute raw and RTE chicken products through 55 stores within the city. Run by Nandakumar's two sons Naveen and Narendra Pasuparthy.

110	**Nensey's Poultry**, Valsad, Gujarat, **300** BPH by RND around 2002. It is learnt to have been sold to an unknown party.
111	**Peninsula Foods** Pvt Ltd, a div of Deejay Group, Bangalore, owned by David Lobo, set up a 1000 BPH Meyn plant in the late 1990's. For tax benefits it was run by a complex arrangement of four Deejay companies. Closed around 1998 following labour unrest which coincided with Lobo's unsuccessful foray into broiler pure-lines with Ross – in direct competition with VH. The plant was scrapped.
112	**Perfect Poultry** Pvt Ltd. Plant and HQ at 27 Ft Road, Chowk Green Field, Majitha Road, Amritsar, Punjab. Earlier 1000 BPH Storm plant being replaced by Meyn 4000 BPH plant. They are retaining only one plucker, screw chillers and some secondary processing items. Storm equipment, suitable after balancing, for **2000** BPH is probably available for sale.
113	**Pioneer**, Hyderabad, Andhra Pradesh, 500 BPH by Dhopeshwar. It has been scrapped.
114	**PL-480 plants**. Even before VH set up their first poultry processing plant in India in 1986, several carrousel track type prototypes from Diamond of USA arrived on grant to the Indian Government under the PL-480 scheme. As far as I am able to ascertain, they were installed in Chandigarh, Mumbai, Aligarh, Orissa, Kerala and Andhra Pradesh. I have seen the one at Chandigarh (CPDO) and the one of **Mafco**, Mumbai, the latter being bought in an auction by VH and mothballed at Kamshet. The Mafco plant is probably scrapped, but the remaining machines may yet be put to use if auctioned by the government
115	**Prabhat Foods**. Established in the year 1963. They sell Chicken RTE products directly to some institutions and also retail through half a dozen outlets in Mumbai. Mhatre, the owner, is related to J. Desai of VH. https://www.prabhatpoultry.com
116	**Pragathi Broilers** Pvt Ltd, Doddballapur, Karnataka, **500** BPH by Bayle in 2013. Closed or probably sold. See also Dr Srinivasa
117	**Ratnagiri Cooperative**, Chiplun, Maharashtra, **300** BPH by RND in 2003 (closed).
118	**Riverdale Foods**, Somatne, Maharashtra, 1000 BPH by Meyn around 1995 installed for Harianawala brothers, ex-employees of VH. It closed around 2003 when its arrangement with McDonalds became unprofitable. Was bought by ANC Holdings, Dubai. The plant equipment has suffered pilferage and is now scrapped.
119	**Ruchi Agro** Industries Ltd, Chikmagalur: It is an RND manual plant of **unknown** capacity.
120	**Royal Foods** Pvt Ltd/Shakir Shaikh, Lohegaon, Pune, Maharashtra, **500** BPH by Storm Engg in Nov 2013 .
121	**Sai Agri**, Kakinada, Andhra Pradesh, 500 BPH used Linco plant imported and installed around 2001 to cater to nearby oil platform workers. Closed shortly thereafter. Bought and mothballed by Srinivasa Hatcheries Ltd, Vizag.
122	**Shiva Chicken**, Coimbatore. Manual dressing of **unknown** capacity http://www.shivaachicken.com
123	**Shiva Farms**, Mumbai. A plant producing a variety of RTE products and cold cuts without the use of machinery
124	**Shiva Poultry Equipment**, Barnala city is operating a **500** BPH processing plant supplied by RND at GADVASU university in Ludhiana. Their brand name as " *Hygrow Chicken*"
125	**Sirsa Foods**, at Sirsa, Haryana. A **500** BPH plant supplied by Storm. Expected to be commissioned in first quarter of 2022.
126	**Sood Poultry** at Jullunder, Punjab. A **500** BPH plant commissioned by Storm in 2020.
127	**Sujay Feeds**, SY No 44B Pillaraju Property, Ganganagar, Bengaluru, Karnataka, **200** BPH manual slaughter.
128	**Swift Foods**, Dadri, Uttar Pradesh. Automatic 4000 BPH processing plant commissioned in the early 1990's by Jagdish Prasad, in competition with VH's Kamshet plant of 1000 BPH. It had an RTE section. Closed around 1995, then scrapped.
129	**Taurus Foods** was set up in the mid 1990's. It produces marinated, smoked and cooked chicken RTE products at its plant at EPIP, Kasna Site 5 Greater Noida, for which it sources raw chicken meat from SHL Agro and others. It has a capacity of 25 tonnes of RTE products per month https://www.taurusfoods.in
130	**Unitas Foods** Pvt. Ltd M. G. Road, Ghitorni, Delhi. Was incorporated in 2004 and operates QSR and food kiosks business as well as serving bulk buyers. It offers chicken meat, vegetable frozen *dimsums* or *momos*, rolls and *samosas* and claims to be the largest producer of *dimsums* in India. http://www.unitasfoods.com
131	**Unnat** Feeds, Sector 12 Huda, near Mittal Mega Mall, Panipat, Haryana. An order was placed on Lark Engineering. Under installation from early 2021, but lack important approvals from the government, therefore commissioning date is unknown. The project appears to have been scrapped
132	**Violet Industries/Souza Hatcheries**, Mangalore, **500** BPH by RND. Not yet commissioned.
133	**Vista Agriculture** & Food Products, Khurdah Road, Bhubaneshwar, Orissa, **500** BPH by Storm Engg in 2013. Now closed;
134	**Walvekar Hatcheries** Ltd, Pune. 1000 BPH plant was confiscated by the Mumbai Customs due to some irregularities. When auctioned several years later, the lot was picked up by Dr C. R. Behl of VH with a view to install it near Bangalore. Later, most of the machines were used by VH to replace run-down Marel machines at their Kamshet facility
135	**WBFCSL**/R. K. **Doloi,** MLA, Midinapore, West Bengal, **300** BPH by RND in 1998, ostensibly for the economic up-lift-ment of local tribals. It was never commissioned. Meanwhile the owner tried selling the equipment or the company, first to Amrit Feeds and then recently (15 Jan 2020) to VH but failed each time.
136	**Zorabian**, Khopoli, Maharashtra, Originally a drum plucker manual dressing facility, upgraded to **500** BPH by RND in 2007.
Note: This list is as exhaustive as I could make it and covers slaughter operations in the un-organized sector. Counting from within this list, I arrive at a total active or potentially re-deployable capacity of 26,700 BPH (23,600 in 38 plants + 5 of unknown capacity = 26,700 BPH) for primary slaughter. Where capacity is not known – I have assumed it to equal the average capacity of the remaining plants within this category.	



4 Bad Design of Air-flow and What Excess Humidity Does to Cut-up, Deboning and Packing Hall (Some Common Bad Machine and Layout Designs, Continued from March 22)

4.1 Cut-up Hall Environment In Tropical Lands

Energy Use by Type-of-Use Within U.S. Climate Regions

Climate Region	Space Heating[1]	Water Heating	Air Conditioning	Refrigerators	Other[2]
Very Cold/Cold	53.6%	16.3%	1.4%	3.8%	24.9%
Mixed-Humid	40.7%	17.6%	6.6%	4.9%	30.1%
Mixed-Dry/Hot-Dry	23.9%	22.7%	9.6%	5.8%	37.9%
Hot-Humid	16.6%	17.6%	21.1%	6.5%	38.3%
Marine	37.4%	21.6%	0.7%	6.0%	34.3%

[1] Includes main (primary) and secondary space heating.
[2] "Other" includes end uses not shown separately (e.g., cooking appliances, clothes washers, dryers, dishwashers, televisions, computers, small electronic devices, pools, hot tubs, and lighting.)

Source: U.S. Energy Information Administration, Residential Energy Consumption Survey. The 5 climate regions are from the Building America program, sponsored by the U.S. Department of Energy's Office of Energy and Efficiency and Renewable Energy (EERE), 2010.

Figure 1 Left picture shows dew drops on a vertical glass surface. Note how the tiny droplets coalesce into bigger drops till they become heavy and slide down. This also happens on the surface of a sandwich panel ceiling.
Right tabulation shows the energy required to heat dry and humid air. It has been reproduced from a post by EnergyForums.net[ii] The post goes on to say "The reason water cools more slowly is due to..[its]..**thermal mass**. Water has more thermal mass than air. [So].. it can store more heat… Humid air has more water in it than dry air, so which do you think requires more energy to cool?... This same concept applies to heating – it takes more energy to heat humid air than dry air…[In this]… chart hot and humid areas use 21.1% of their energy on air conditioning each,.. while hot and dry areas only use 9.6% of their energy to air condition[iii]. It's a wonderful thing that water condenses out of the air as it is cooled..[because].. homo sapiens are most comfortable in a relative humidity of 40% to 60%...[and]… mould needs an environment of greater than 60% relative humidity to live. So it is vitally important to keep building environments at or below 60% relative humidity. Cooling air squeezes the water out of it and gives us some control over humidity."

In tropical environments ambient temperature in all poultry processing departments preceding the packing hall is typically between 25° and 35°C and is saturated with moisture. The moisture content ranges between 75% and 100%, owing to the extensive use of water. But in the packing hall we need a temperature of 12°C. So we refrigerate the air. Additionally it needs to be as dry as possible. These requirements pose severe engineering challenges at the design stage and call for strict operating conditions to be followed throughout the life of the plant.

The typical poultry processing plant can be divided into the dirty area comprising (a) arrival and lairage, (b) hanging, (c) stunning, slaughter, bleeding, scalding and defeathering, (d) evisceration, (e) chilling, portioning, deboning and packing; and finally (f) storage and dispatch. Of these (a) to (d) are considered dirty areas, typically held at ambient temperature, while (f), designated clean area, is held at around 12°C.

Some Definitions	
Dry and wet bulb thermometer, Relative humidity (RH), Dew point & Saturation, Fog, Mist and Rain. HEPA filter, Psychrometric chart. Sensible heat and Latent heat	**Dry-bulb temp** is the correct air temperature. In a **Wet-bulb thermometer** the bulb is wrapped by a wet cloth so it cools through evaporation. Both temperatures are identical at **relative humidity** of 100% (**saturation**). The amount of moisture air can hold at different temperatures varies – practically nil at freezing temperature and maximum at high temperatures (for instance 22gms/CuM at 25°C). If the moisture content of air is a fraction of 22gms/CuM at that temperature, say 50%, that fraction is the **relative humidity** of that air. Therefore comparing the dry and wet bulb temperature readings allows one to measure the level of **relative humidity.** When clouds cool rapidly, they **saturate**, and then **rain**. Cool air slowly, it **saturates** and then **mist** and **fog** forms. And, excess moisture condenses as **dew**. **HEPA** refers to high efficiency particulate air filter. It is made of paper, fitted into the filter system and needs frequent replacement as it gets choked with particulates. The relationship between air temperature, air pressure and saturation humidity is best expressed in a **psychrometric** chart. Download it from Google and examine it. **Sensible heat** is what we feel. **Latent heat** is what is there in the substance in the form of energy, but we cannot feel it.

Figure 2 Important concepts and terms used in discussions on state of internal climate of slaughterhouses

Within area (f) you have a heavily saturated ambience occupied by the screw chiller and the cut-up, portioning, deboning and packing area which must be as dry as possible. The last (g) is actually not a work area, as it remains for the most part unoccupied by workers.

In the dirty sections, the bleeding trough is the biggest source of smell and aerosols in a poultry processing establishment. During bleeding, birds often shudder and flap and this releases blood droplets and dead epidermal cells as aerosols. The best and most effective method of removing this odour and aerosol load is to place an aspiration hood over the trough and aspirate the air, to be vented at some height and distance from the premises as shown in figure 6.

However, unless you implement a strict unidirectional movement of air, from the packing hall to screw chiller to EV to killing and defeathering and on to live bird hanging, a lot of ambient moisture and aerosols in these areas move naturally into the packing hall.

Additionally, wet carcasses moving to the packing hall contribute some moisture which increases the humidity level of the ambient air. All these factors may make the humidity level in the packing hall excessive – eventually in the course of the operating shift reaching 100% and remaining at that level. The question is, how does 100% or saturation humidity level affect operations ?

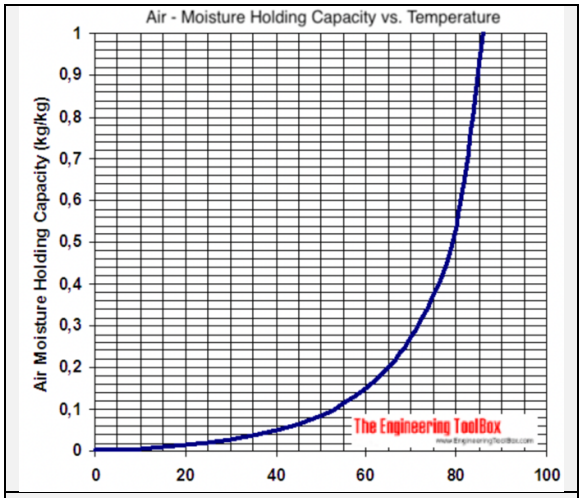


Figure 3 Moisture holding capacity of air at different temperatures at sea level. At sea level air has the highest density. It falls as you increase the elevation. Since poultry processing plants in India are generally rather close to sea level, this point may be ignored here. Source: The Engineering Toolbox

To begin, we must note that excess moisture is naturally expelled by air in the form of fog or dew. Fog is easy to note – it reduces visibility. Dew becomes evident when you notice little droplets condensing on metal surfaces.

In the packing hall, such condensation is not only noticed on machines, but also on the ceiling as it is metallic, being constituted of GI or stainless steel on both sides of an insulating matrix. This condensate on the false ceiling drips down on work surfaces and on carcasses.

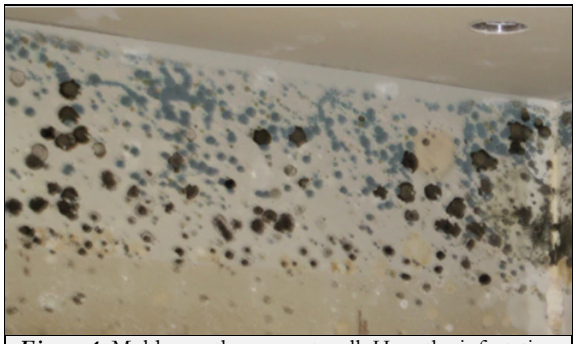


Figure 4 Mold growth on a wet wall. Here the infestation is excessive. But on your panel ceilings you may see only faint black rings – they mark the start of the process and at that stage are enough to cause product contamination

Why does water get expelled in the form of dew and why does it condense on surfaces? To understand this, look at figure 3. It tells you how many grams of water in the form of water vapour a cubic metre of air at a given temperature can hold. Notice that the amount *decreases* as the air temperature *decreases, but not linearly*. So as air cools, there comes a stage at which the excess quantity of water that it held at a higher temperature must eventually be expelled. It does so in the form of fog or dew.

Air in the screw chiller room is always either saturated or very close to saturation. And since the screw chiller room is not refrigerated, it is almost always between 25 and 35ºC in tropical lands. Meanwhile air in the cut-up room needs to be refrigerated to 12ºC. So when saturated air from the screw chiller room migrates into the cut-up room, it always raises the ambience of the latter closer to saturation levels.

Figure 5 shows two real life instances where plant engineers and draftsmen have failed to grasp this concept. They positioned a chain and shackle washer incorrectly. A chain and shackle washer is in effect a very efficient humidifier. No other machine in use in a poultry processing plant comes close to it. When you place this machine in the cut-up hall, you are going dead against the above rule.

4.2 Aerosols and Bioaerosols

Chicken carry a yellow dandruff like powdery substance on their skin and in their feathers- a sort of fine epidermal debris. When they flap their wings, as they do when they are hung in shackles, they release this powder. It tends to fly around and coat all surfaces and is prone to spread all over and into the plant interior and cause serious contamination. Examine the drive motor fan cowling in the killing line and you will notice that it is covered with this substance.

Particularly in large plants the best way is to suck this yellow dust with the help of an aspiration system installed over the live bird hanging station. It additionally protects the workers engaged in live bird hanging. Figure 6 shows such an arrangement. The aspirated dust is compacted in a cyclone and disposed off from time to time.

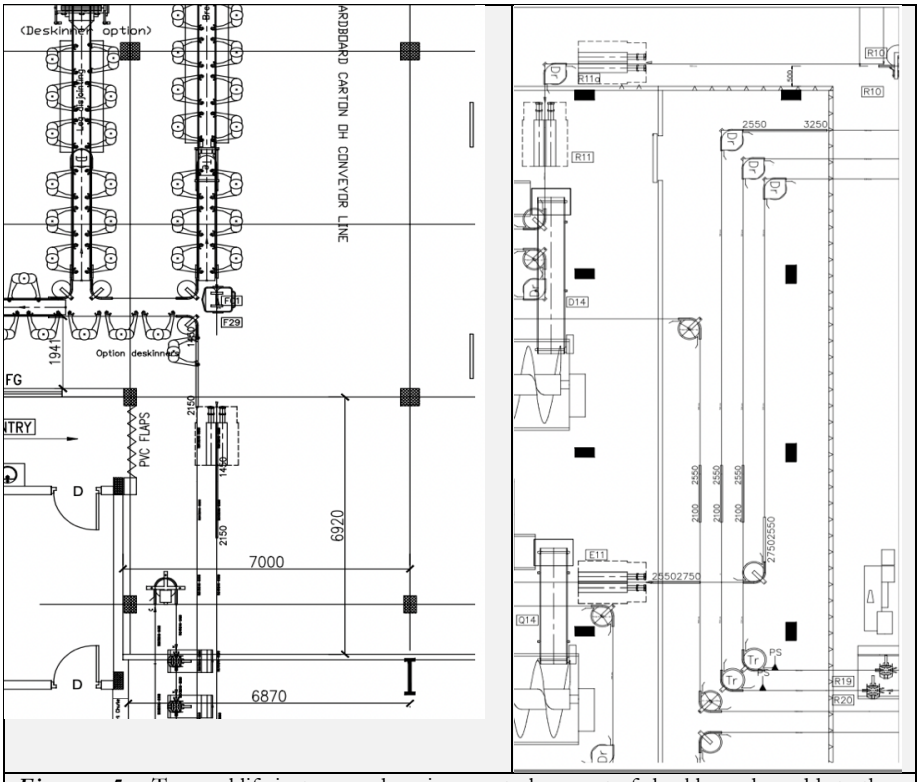


Figure 5 Two real life instances where incorrect placement of shackle washer adds to the moisture levels in the cut-up hall. Drawing on the left shows a shackle washer placed in the packing/cut-up hall unilaterally by the plant engineers without consulting Meyn. On the right you see three shackle washers. The one at the bottom is for weigh line A. At the top are two alternative positions for the second shackle washer for weigh line B. To reduce moisture to the weighing cum packing hall on the right, I had placed it inside the screw chiller room. An Dutch draftsman with 20 years of design experience "improved" my layout by moving it out of the chiller room, ostensibly to "maintain symmetry"! He then threw a tantrum and left the project team.

You may have wondered that since bacteria, fungal spores chicken dust and viruses are too tiny for a face mask to stop – weaving gaps in the fabric of a mask are too large to accomplish this. So why were all experts unanimous about the use of face masks in restricting the spread of Covid-19?

Because these pathogens do not float around on their own in air. They are so tiny that physical properties of water in which they exist prevent their liberation as airborne, free-gliding Olympian sky-divers. They are present and viable only in coughed or sneezed-out water droplets, known to us as aerosols, or in this context, as bioaerosols generated within the dirty areas of the plant. And bioaerosols are large enough to contain thousands of such microorganisms under viable conditions. Although they are so tiny, they may be stopped by simple mechanical means like face-masks, or in our case, by ensuring proper directional flow of air. Watch Richard Feynman's talk to grasp the concept[iv]

After becoming airborne, an organism may have a very short life, its stability being influenced by RH, temperature, oxygen levels, solar and ultraviolet (UV) radiation, and chemical factors.

Aerosols contain nutrients – for growth and sustenance of microbes including bacteria and fungi. Aerosols also contain proteins, which come from the surface of poultry or from their interiors. When aerosols get absorbed in these droplets, microbial colonies form and thrive in them. Eventually, when they fall on to the product, there is absolutely nothing you can do. Your product has already reached the final process step – you do not wash it before it goes to the consumer.

Most of the microbes are mainly brought into the plant by the chicken themselves, on the skin and in the guts. It is the role of good plant layout and machine design to separate this load from the final product.

Contaminants from workers and ambient loads are relatively smaller and easier to tackle, although the quantities are by no means small! It has been found by Schmitt that a slowly gesturing person [located, for example, in the cut-up hall] generates approximately 500 000 particles/min and a rapidly gesturing person will generate 5 000 000 particles/min[v].

To sum up, there are many important reasons to implement a purpose-designed air movement regime in your plant to keep the ambience of the cut-up room at low temperature and humidity levels and free from microbial contamination. In terms of temperature, the former at +12°C and the latter to as close to completely dry air (meaning zero grams of water vapour per cubic metre of air as possible) and to direct the movement of bioaerosols and aerosols. These are:

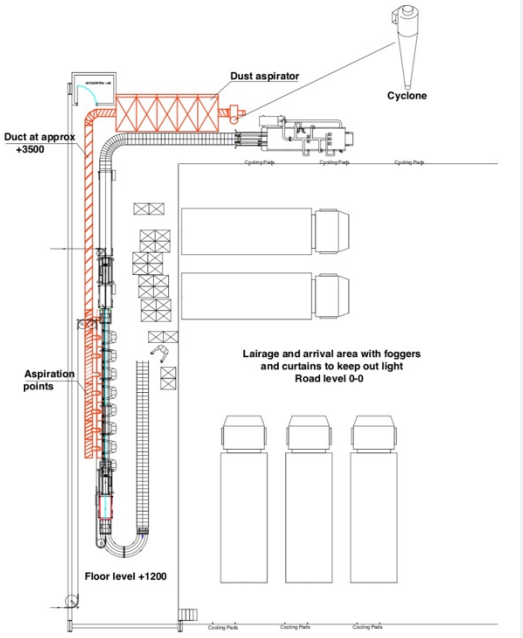


Figure 6 Dust aspiration system (shown in brown) for an 8000 BPH layout. Note also the presence of fan and pad coolers and foggers for stress-free parking of live birds

(a) Firstly a high humidity level of air increases your refrigeration bill. Humid air takes a lot more energy to cool than dry air does. To reduce operating cost you need to avoid high humidity levels.

(b) Secondly high humidity levels are unhealthy for workers.

(c) High humidity levels encourage growth of mold. See Figure 4. Humans are comfortable at humidity levels of less than 60% while molds thrive at humidity levels upwards of 60%.

(d) Chicken meat must leave in packs with as little surface moisture as possible. Surface water leads to microbial multiplication – the growth activity being designated A_w or water activity. With very low surface moisture levels, microbes may stay alive, but not multiply. Therefore not maintaining a dry ambience in the cut-up room results in low shelf life of your product.

(e) Saturation increases product contamination. Figure 4 shows a very common observation which is always associated with condensate dripping from the false ceiling. It is a fungal growth on a wet surface. Remember the dew settled on the drop ceiling? It slowly coalesces into a big drop of water – not yet big enough to fall down, but big enough to absorb contaminating particles, such as aerosols generated in machines like scalder, plucker, vent cutter, bleeding troughs, chain and shackle washer, gizzard processing, badly designed floor gutters and even just swinging movement of carcasses on overhead lines.

(f) Finally, ensuring evacuation of air from the cut-up room and replenishment of the same with fresh outside air ensures evacuation of carbon dioxide. This is essential to ensure a healthy working condition and to raise productivity. We will dwell in detail on this aspect later.

To move plant air the way we desire, an air-pressure control system is required to maintain a positive air pressure in areas where the final product is exposed so as to minimize the contamination rate. An over-pressure of 45 Pascals (Pa) at the cleanest area, 30 Pa at a less clean zone, 15 Pa in the change area and 5 to15 Pa in the facility room give a good pressure gradient[vi].

So what steps can you take to prevent this?

(a) Firstly ensure that there is a wall separating the screw chiller room from the packing room. I have seen some designs, made even by industry leaders, ignore this.

(b) Implement positive air movement from the packing hall to the screw chiller room, onwards to the evisceration room to killing and defeathering and then on to live bird hanging, in that order. Such a regime of forced air movement will determine the direction of movement of aerosols and ensure that they do not enter the packing room.

(c) Ensure that placement of machines does not inadvertently add to increase of humidity in the packing hall.

The largest number of workers operate in the packing hall because much of the portioning, deboning and packing are off-line activities less amenable to automation. This is not true in some plants that only produce whole carcasses, but the majority do.

Next, because many workers operate in this section, it is necessary to change the ambient air several times per hour to introduce oxygen and remove exhaled carbon dioxide.

This is called the air exchange rate and relates to the number of times the enclosed volume of air is replaced per hour.

Finally, because every person is a source of heat, the ambient temperature increases beyond the prescribed 12°C. Also some heat load is contributed by machines such as packing machines, portioning disc cutters, cone deboning machines etc. Were this heat load not removed, the ambient temperature would also rise, contributing to reduction of shelf life.

Gases in Air	Oxygen	Carbon dioxide	Nitrogen	Argon	Total
Fresh air (%)	21	0.04	78	1	100
Exhaled air (%)	16.5	4	78	1	100

Table 6. The average exhaled air, in contrast to fresh air, has 4% carbon dioxide, which, compared to inhaled air, is 100 times larger. So don't disbelieve the keen gardener's remark that "potted plants grow better when you talk to them." By talking you are giving them plenty of food, which is carbon dioxide.
If a person were to continue breathing his own exhaled air, he would not run short of oxygen – 16.5% oxygen content is quite enough. Instead, he would start experiencing **carbon dioxide toxicity**, for which ASHRAE and many other standards prescribe an upper limit of 5% for carbon dioxide. The task of HVAC engineers is therefore to supply enough fresh air so that the carbon dioxide toxicity level is not reached. **HVAC engineering norm is to supply 2.7 CuM of fresh air per person per minute which is equivalent to 816.5 CuM of oxygen per day** Ref.: Modified from The Engineering Toolbox - Human Need of Air, www.EngineeringToolbox.com.

4.2 Conventional Wisdom And Its Downsides

To understand how an engineered air movement regime is established, we must examine the generalized layout of a processing plant. Figure 7 shows this.

The figure shows why conventional methods of air extraction have counter-productive results. Gutters, wall openings and purpose-installed exhaust fans near the ceiling in each of the inter-departmental walls provide the path for movement of air from department (f) towards department (b). The exhaust fans need be no bigger than bathroom extractors placed strategically in a staggered arrangement to not just extract air but also create turbulence inside the halls to facilitate proper mixing.

In general the temperature regime within departments (a) lairage, (b) hanging, (c) killing and (d) are ambient. They are not air-conditioned. When cool air from (f) packing and (e) chilling passes through them, it performs a better cooling action than mere fans can.

It has been standard practice to have air extraction fans in each department. See part 3 in figure 7. It shows two extraction fans each in killing and EV. If the EV fan is turned on while the killing fan is not, or the former performs better than the latter or the former is turned on before the latter is, you will get aerosol movement in the wrong direction[vii].

If the blowers in the screw chiller hall are mounted INSIDE the hall, there is no net movement of air from or to that hall. This is a shameful waste of power and an even more shameful generation of excessive noise – so detrimental to rehang workers working in that hall.

In order to bubble air through the water present inside the chillers, roughly a metre – the blowers generate approximately 1/15 atmospheric pressure and deliver approximately 160 cubic metres of compressed air per hour each. Were the blowers to be mounted on the roof and take in atmospheric air through HEPA filters to deliver into the chiller water, they would generate a positive pressure in that hall and thus help drive aerosols and stale, moist air towards the live bird hanging area. Of course, doors leading out of the cut-up area at the other end will have to be spring loaded so that they do not allow air to move in the wrong direction.

But in order to set up an engineered air flow regime needs the cooperation of your refrigeration vendor. He needs to draw in fresh outside air, refrigerate it to +12ºC and then pump it into the packing hall at a rate designed to establish the desired air-exchange rate. This takes more refrigeration capacity than his initial mandate (if you had not factored this need in the old purchase order). So if you are attempting to retrofit this feature, allow him to calculate the added refrigeration capacity and invoice you for implementing it.

On the other hand, if you are planning a grassroots facility, do share this document with him and let him apply

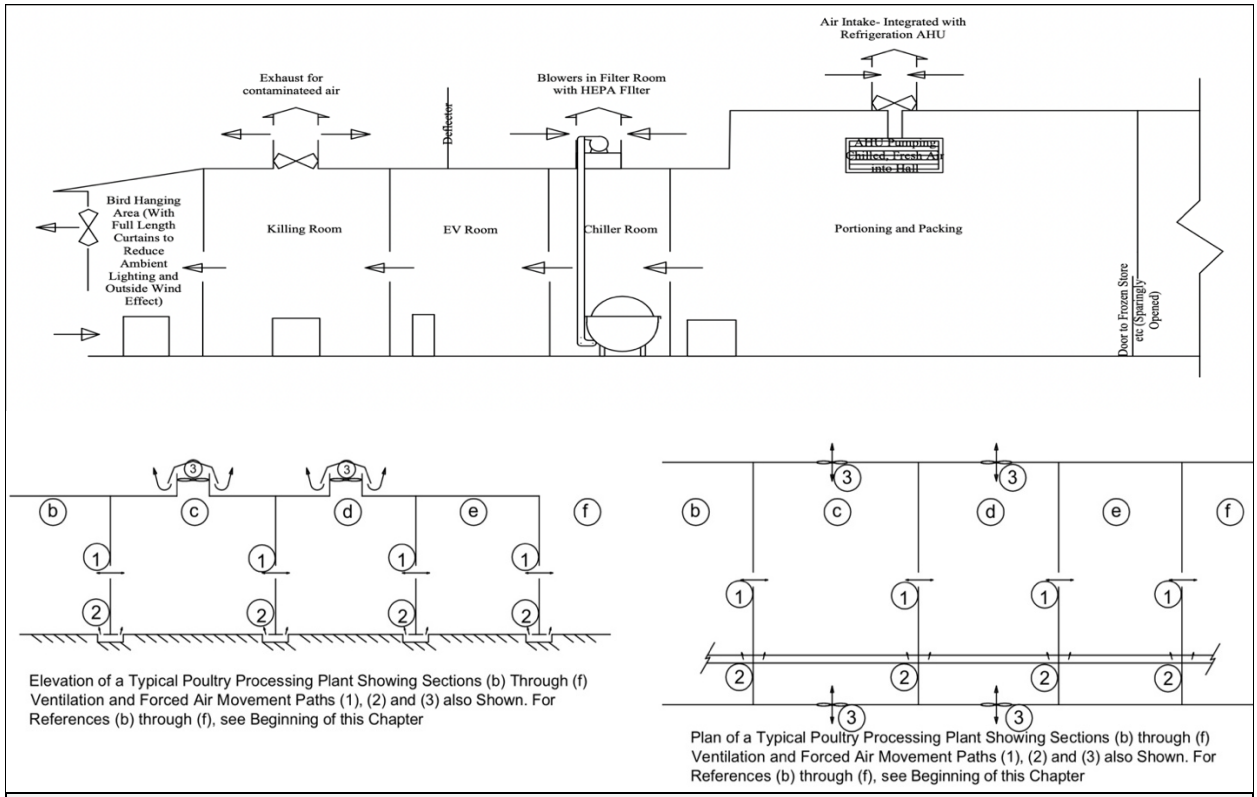


Figure 7 Conventional cross and roof extractor based ventilation methods. Notations (1) = wall openings for overhead lines and doors between sections allowing flow in both directions, (2)= floor gutters between sections, also allowing flow in both directions, (3) = forced ventilation, either by roof extractors or ventilator fans in a conventional poultry processing plant layout. b= live bird hanging, c=killing, d=EV, e=chilling, f=packing. These sketches are from my handbook on design of poultry slaughterhouses. It will be on the website in a couple of months, for free downloading by all. Ref.: Modified and expanded from the original idea in Ventilation of Poultry Slaughtering and Processing Plants[viii].

his mind. Thumb-rules for these design ideas exist – the pharma industry has been using them for years! And of course, both you and your vendor are free to call Aptec and seek explanations.

Three factors are essential for this engineered air movement system to work.

Firstly it is assumed that doors leading to (a) the product dispatch bay, (b) packing material store, (c) returned crate wash room, and (4) packing hall workers' rest rooms, all of which open into the packing hall, with the last three mentioned opening indirectly, through the intermediation of a corridor, are provided with self closing doors and in fact are not very frequently opened. If this is not done, positive pressure built in the packing hall will get dissipated and air movement will not occur in the correct direction.

Secondly remember that air vents, where provided, are placed sufficiently above the roof surface. Exhausted air tends to hug the nearest surface and it has been shown that foul air from the toilet block exhausted by the help of ventilation fans can get sucked back through the air intake HEPA filters provided for AHU intake and screw chiller intake[ix].

And **finally** do factor in an asymmetrical wind load on the building walls and roof. Wind blows in specific directions in monsoon countries – it is not random. It exhibits seasonality.

4.3 Do The Math

Now let us look at some real life scenarios

Assumptions: Your process rooms, (hanging, killing, EV and chilling) and corridor spaces contain saturated saturated air and because of the large quantity of water in the screw chillers, (which is housed adjacent), are collectively introducing 500 cubic metre of saturated air at an average temperature of 25°C per hour into the cut-up-packing hall. Your cut-up and packing hall has a capacity of 37.9x16.3m and a height of 6m = 3707 cubic metres and it operates at +12°C		
Cut-up hall volume in cubic metres	37.9x16.3x6	3707 CuM
Saturation level water held as vapour in the ambient air of Cut-up room at 12°C	7.4 grams/CuM (7.4x 3707)	27.4 Kg
Amount of water in saturated air in the form of water vapour	From figure 3	16.5 Kg
Ingress of saturated air at 25°C from screw chiller room at 500 CuM/hour, per hour	16.5 grams/CuM for 500 CuM per hour	8.25Kg per hour
Temperature rise in Cut-up room per hour if the air mixes and mixed air bleeds out through open doorways, across strip curtains etc.	(3707x12+5000x25)/2 (44484+12500) /2 =84742 84742/3807= 22.26°C	22.26°C
Increased temperature of Cut-up hall is now 22.26°C. So it now holds close to 15 grams of water vapour per CuM	But since the refrigeration plant is working hard to bring the temperature down, all this extra moisture condenses. Some of it on the ceiling.	
Table 8 Calculations for your Cut-up Hall		

Now carry out the same calculations with a cut-up hall having a low ceiling – say at 4 metres. See how much worse the situation becomes!

5 AptecApp and AptecAppL

Aptec has placed an App on its website. The purpose of this App, designated **AptecApp**, is to facilitate entrepreneurs interested in the poultry processing industry to choose, configure and seek in-principle nod from their bankers for financial participation in their projects. They can then send their configuration, consisting of a print version of the App to their vendors and obtain commercial offers.

We have constructed the App examining how a real entrepreneur normally goes about conceiving of and configuring his plant. A sort of wish-list, if you like.

He first studies the industry, and when he is convinced, he gets a chartered accountant to prepare a *techno-economic feasibility report.* Now a good chartered accountant is familiar with the *economic feasibility* part, but he may not know enough about the *techno feasibility* part. This is where he approaches a technocrat to learn the ropes. Often he does not learn enough, or the technocrat holds back some crucial details.

How much better it would be if the chartered accountant had complete access to the technology part with the help of a computer App? This is where **AptecApp** steps in. It contains all the information needed by a lay person to prepare a complete and technically correct feasibility profile for one among five project choices (namely two versions of start up 1300, 2500, 4000 and 6000 BPH). It does not bother the entrepreneur with technological issues – it uses technological rules internally for calculations and blocks the entrepreneur from making untenable decisions.

The App allows the user to configure his project according to his wish list. He may alter the bird weight, hours and days of production per day and per year, change the ratio of fresh-chilled and frozen products and alter his product mix consisting of whole dressed broilers, portions, deboned and curry cuts and effect of over-speeding and under-speeding of the line, all within certain technological parameters.

As a result he can grasp the sensitivity of his bottom line to hours of operation, capacity utilization, live bird weight and price, number of workers and wages, and a number of other variables. He can now query the App with many "what ifs" and get instant answers. In addition a **Wizard** built into the App conducts an audit and recommends modifications to his line-up of machinery, suggesting additional machines and noting how many workers he may then reduce and affect a saving in operating cost. At this point his profile is also useful for him to approach bankers and obtain in-principle assurance of participation in the project.

This App is free for anyone to download and use. It comes complete with a Readme First file and PDF versions of layout drawings for all five projects.

AptecAppL

This is the long version of **AptecApp**, containing full formats to compile vendor bids, make the project easily understood by bankers and also allows further modifications to project details. This will be a paid version – likely to be uploaded by March 2023. Details of features to be included in it have been mentioned graphically in the documents included in the **AptecApp** zipped file downloaded from the Aptec website www//aptec.in.

With the help of **AptecAppL**, the entrepreneur and his chartered accountant or project manager can prepare a complete 10 year projection, besides modifying the initial configuration for financial improvements. Later, when the plant commences commercial operation, it lets him optimize his production plans from day to day with the aim of maximizing his earnings.

6 Sources of Plant and Auxiliary Equipment, Utilities and Supplies Required for Setting Up and Running a Poultry Processing Plant

I have listed vendors of all manner of machinery, utility systems and supplies that one may need to contact when setting up a poultry processing plant or running it. As always, I do not make recommendations - merely list the vendors. Nor do I take any liability for your choice.

After March 2023 we expect to place this as a stand-alone document on our website. It will no longer form a part of this Report.

Table 10 Aptec List of Sources - Capital Goods, Supplies for Poultry Processing	Rev 2, Date 21 Oct, 2022
Articles, Scientific, Technical	Scientific Articles, repository of [1]
Audit and Consultancy	Biosecurity Audit for Certification [3.1], Hygiene Audit [3.2], Time and Motion Performance Audit [3.3], Layout and Work-flow Audit/Design [3.4], Poultry Processing Project Engineering Consultancy [3.5], RTE Formulations [3.6], RTE Test Kitchen [3.7],
Biosecurity	See Hygiene, …….
Boilers	Steam Boilers [5.1], Hot Water Boilers [5.2],
Clean-in-place, Steam-in-place	See Hygiene, Housekeeping….
Compressed Air,	Air Compressors [7.1], Compressed Air Dryers [7.2], Purge Valves [7.3]
Controls	Control Panels [9.1], Processing Plant Compatible Drives, Motors [9.2], Temperature Controller [9.3], VLT [9.4],
Consumables	[7]
Conveyors	Belt Conveyors [11.1], Modular Conveyors [11.2], Roller Conveyors [11.3],
Coops, Crates	Coops or Crates for Live Poultry [13.1], Product Crates [13.2], Fresh Product Crates [13.3]
Design, Plant Layout	See Audit
Doors	Docks for truck loading bay [15.1], Dock Leveller [15.2], Dock Shelter [15.3], Hatch Door [15.4], Polymer Sheet Doors [15.6], Refrigeration Doors [15.7], Sliding Door [15.8], Wicket Door [15.9], Rolling Shutter [15.10], Emergency Door [15.11], Fire Resistant Door [15.12]
Directory	[17.1]

Flooring	Acid-Proof Flooring [19.1], Anti-Slip Flooring [19.2], Kota Stone Flooring [19.3], Polymer Flooring [19.4],
Face Shields	See Hygiene….
Fire Safety Equipment	Fire Resistant Doors [21.1]
Hygiene, Housekeeping, Biosecurity, Safety, Supplies	Air Curtains [23.1], Air Showers [23.2], Air Tunnels [23.3], Bio-hazard Bins [23.4], Brooms [23.5], Clean in Place [23.6], Dustpans [23.7], Entrance Solutions [23.8], Floor Washing & Mopping [23.9], Foam Washing Systems [23.10], Gun Lance for Plant Washing [23.11], Hepa Filters [23.12], High Pressure Washers [23.13], Hygiene Station [23.14], Industrial Vacuum Cleaner [23.15], Laundry, Washing Supplies [23.16], Plant Washing System [23.17], PP Gear [23.18], Rodent Control [23.19], Steam in Place [23.20], Strip Curtains [23.21], Vacuum Cleaner, Industrial [23.22], Washroom Accessories [23.23], Waste-bins [23.24],
Lamp, Electric/Luminaire	Incandescent [25.1], Fluorescent [25.2], LED [25.3], HP Sodium Vapour [25.4],
Laundry Equipment, Industrial	Washing Machines [27.1], Ironing Equipment [27.2]
Packing Machines and Supplies	Adhesive Packing Tape [29.1], Batch and date code printing [29.2], Bar-coding, QR Code [29.3], Branding, Date & Product Information Printing Equipment [29.3], Cloth Tape [29.4], Coding Solutions [29.5], Impulse Heat Sealer [29.6], Duct Tape [29.7], Labels [29.8], Low Temp Stable Sealing Tape [29.9], Manual Tape Dispenser [29.10], Masking Tape [29.11], Pack Labelling, Pack Printing Machines & Materials [29.12], Packing Machines [29.13], Tape Sealer [29.14], Traceability Systems [29.15], Wicket Bag Sealing Tape [29.16], Shrink Tunnel [29.17]
Personal Safety	See Hygiene…..
Pest Control	See Hygiene…..
Poultry Processing Plant, Machinery	Automatic Poultry Processing Equipment [31.1], Manual Poultry Processing Equipment [31.2], Table [31.3], Trolley [31.4], Metal Detector [31.5]
Poultry Further Processing Plant, Machinery	Further Processing Equipment for meat [33.1], Kitchen and Scullery Equipment [33.2]
Processing Tools, Components, Supplies	Apparel [See Hygiene….], Blood Pump [35.1], Butchers Steel [35.2], Cleaning Chemicals [35.3], Circular Knife [35.4], Feather Pump [35.5], Hock, Giblet Pump [35.6], Knife Grinder [35.13], Portioning/filleting Knife [35.7], Plucker Fingers [35.8], Pump [35.9], Semi-automatic Hand Tools [35.10], Slurry Pump [35.11], Crate Washer [35.12],
Refrigeration Systems	Ammonia Systems [37.1], Cryogenic Freezer [37.2], Evaporator [37.3], HCF System [37.4], Ice maker [37.5], Ice Packs and Dry Ice [37.6], Plate Heat Exchanger [37.7], Sandwich Panel [37.8], Tunnel Freezer [37.9], Refrigeration Turnkey [37.10], Spiral Freezer [37.11], Acoustic Insulation Panel [37.12], Rock-wool Panels [37.13], Cryogenic Gas [37.14]
Rendering Plant	Rendered Meal Bulk Buyer [41.1], Rendering Plant [41.2],
Rodent Control	See Hygiene
SS Custom Fabrication	[43.1]
Temp Measurement, Control & Logging	Electronic Digital Hand-held Thermometer [45.1], Glass Thermometer [45.2], Process Temperature Controllers [45.3], Temperature Dial Gauge [45.4],Temperature Logger [45.5],
Vacuum Systems	Vacuum Pumps [45.6], Vacuum Conveying Equipment [45.7]
Ventilation	Air Curtain [47.1], Exhaust Fan [47.2], Roof Extractor [47.3],
Waste Handling , Treatment	Raw Water Treatment [49.1], Solid Waste Management [49.2], Wastewater Treatment [49.3], Ozonation [49.4]
Weighing Systems	Bench Scale [51.1], Check Weighing Machines and Systems [51.2], Floor Scale [51.3], Multi-head Weighing Packing[51.4], Platform Scale [51.5], Pan Scale [51.6], Weighbridge [51.7], Weighing Machines [51.8]

1	**Airtècnics,** C/ Conca de Barberà, 6**,** Pol. la Bruguera**,** 08211 - Castellar de Vallès**,** Barcelona Spain https://www.airtecnics.com, +34 937 15 99 88 [47.1],
2	**Aman Enterprises** B9/147 Sector 4, Rohini, New Delhi-110085, +91 11-27062171, (M) +91 9350525443, +91 9958048947, +91 9310125442, amandevki@gmail.com, info24amanenterprises@gmail.com, www.amanenterprise.co [37.1], [37.4], [37.10],
3	**Ammeraal Beltech India**. Unipunch Pride, 3rd Floor - G1. Door No. 40, 2nd Main Road, Ambattur Industrial Estate, Chennai, 600058, India. +91 44 2653 4244, www.ammeraalbeltech.com, +91 99405 97646, +91 99403 08049, Jebbel Paul. [11.1], [11.2], [11.3],
4	**Altomech Pvt Ltd,** 3/519, SF.NO:108/4, Manickapalayam Road, Manickapalayam, S. S. Kulam (via), Kunnathur Pudur Post, Coimbatore, Tamil Nadu, India-641107. +91 95851 33033, info@altomech.com , altomech@gmail.com, www.altomech.com, [45.7], [23.22],
5	**Aptec** (Alok's Poultry Technology Pvt Ltd), 282, Power Officers' Society, Plot 14-15, Pocket 2, Omega 1, Greater Noida 201310 India. [3.3], [3.4], [3.5],
6	**A & S Thai Works Co Ltd,** 99/199 Moo 1 Theparak Road, km 22 Bangsaothong, Samut Prakan 10570 Thailand. +66 2313 1540, Fax: +66 2313 1550, sales@asthaiworks.com, www.asthaiworks.com, [41.2],
7	**Atco Sensors Ltd**, Katrak Road, 6 A Lalwani Industrial Estate 14 G D Ambedkar Road, Wadala. City, Mumbai. State, Maharashtra 400031, India, www.atco-industries.com, [51.7],
8	**Avery India Ltd**, Plot Nos. 50-59, Sector 25, Ballabgarh, Haryana 121004, India. +91 129 409 4400 +91 129 409 4500 www.averyweigh-tronix.com, [51.7], [51.5], [51.8], [51.1],

9	**Bala Industries and Entertainment Pvt Ltd** (Formerly V. J. Equipment Pvt Ltd) Gat No.88, Village Jambhul, Tal Maval, Pune 412106, Maharashtra, India. www.balaindustriesincubator.com/, [13.1], [23.11], [23.19], [23.22], [23.9],
10	**Bayle (India),** 17/1 Tatya Tope Society Phase 1, Opp Shivarkar Garden, Wanowrie, Pune, India +91 95525 65264, shekhardcruz@gmail.com, Rajshekhar D'Cruz, [31.1], [31.2],
11	**Blue Star Limited**, Kasturi Buildings, Mohan T Advani Chowk, Jamshedji Tata Road, Mumbai - 400 020, India. +91 22 6665 4000, 1800 209 1177, Fax: +91 22 6665 4151, [37.4], [37.8],
12	**Bright Industries**, 286/1 NKT Nagar, Vivekanandhar Street,, Nanjegouden Pudur, G N Mills Post,, Coimbatore 641029. +91 93632 28481, +91 98947 88786, bright_ind@hotmail.com. Abdul Nazar, [11.3], [43.1],
13	**BSA India Food Ingredients Pvt. Ltd,** Tower C 806 Unitech Business Zone, Nirvana Country, Sector 50 Gurgaon NCR, India. Amod V. Apte, +91 86969 24195, +91 124-4049807, www.bsaindia.in [3.6], [3.7],
14	**Carfed S.A.** 10 – Zona Industriale, San Giuliano Milanese, Lombardy, 20098, Italy. info@carfed.it Manufacturers of poultry crates, http://www.carfed.it/poultrytransportation, [13.1],
15	**Control Print (India) Limited**, Sector 4, Noida, Gautam Budh Nagar, Uttar Pradesh, India. +91 22285 99065, +91 22669 38900, sales@controlprint.com, [29.2], [29.3], [29.5],
16	**Danfoss Industries Pvt. Ltd**, Unit No. 602, 6th Floor, RMZ Millenia Business Park II, 4B Campus, No. 143, Dr. MGR Road, Perungudi 600096 Chennai, India. danfoss.india@danfoss.com, www.danfoss.com, [9.4],
17	**Deccan Automation Technology**, SR No. 20 Katraj Kondhawa Road Vidyanagar, Pune 411046, Sukhadev Darekar, +91 74477 81112, deccanautomationtech@gmail.com, , [31.1], [31.2],
18	**De-Ion Systems,** C-281/1, 7th Cross, 1st Stage, Peenya Industrial Estate, Bangalore 560058 India. S. Jagadish Bhat, +91 98454 48835, +91 80-28392127, jagadishbhat2002@yahoo.com, info@deion.co.in, [49.1], [49.3],
19	**Dhopeshwar Engineering Co,** A-16 Cooperative Industrial Estate, Batanagar, Hyderabad 500 037. dhopeshwar@gmail.com. Shirish Dhopeshwarkar [31.1], [31.2],
20	**Dhumal Industries**, E – 36, D Road, MIDC, Satpur, Nashik – 422007, MH, India. +91 982 208 4683, +91 25 3257 6084, sales@dhumal.com, www.dhumal.com, [13.1], [13.2], [23.18],
21	**Directory of Vendors for Food Processing Industries Worldwide,** www.hyfoma.com/en/companies, [17.1],
22	**Diversey Global Headquarters**, 1300 Altura Road, Suite 125, Fort Mill South Carolina, 29708, (803) 746-2200, (800) 668-7171, (800) 558-2332, (800) 842-2341, [23.10], [23.16],
23	**Domino Printech India LLP**, Plot No. 167, HSIIDC Udyog Vihar, Phase 1 Gurugram, Haryana 122016 India +919599488058, enquiry@dominoindia.com, [29.12], [29.3], [29.12],
24	**Dr Froeb (India) Pvt Ltd** (Agent of Linco), C-20 Sector 2, Noida 201301, India. +91 98110 89930, Athul Jain, atul@drfroebindia.com [31.1], [31.2], [33.1],
25	**Duram Rubber,** Amnon Ben Peretz, +972 9-7474458, +972 9-7474479 , duram@ntvision.net.il, [35.8],
26	**E- Pack Polymers Private Limited** 61 – B & C, Udyog Vihar, Surajpur, Kasna Road, Greater Noida.(U.P.) India. Pin 201306 +91-8130444477, sales@epack.in , [37.8],
27	**Elgi Compressors,** Toll-free (India) 1800-425-3544, , 1800-203-3544, enquiry@elgi.com, , www.elgi.com, [7.1],
28	**Envair Electrodyne Ltd** (formerly Kirloskar Electrodyne) 117, S-Block, MIDC, Bhosari, Pune 411026, Maharashtra, India. **www.kirloskars.com**, [23.12],
29	**Enviro Care India Private Limited**, #43, 2nd Street, AA Rd, Madurai, Tamil Nadu 625016, India. +91 98211 78781 www.envirocareindia.com, [49.1], [49.3],
30	**Eureka Doors,** 203, Vikram Goldmine Opp Venus Traders Behind Hotel Rupali, FC Road, Pune 411 004. Maharashtra, India. +91 8888 78 4444, +91 – 9373040830, sales@eurekaindia.com, info@eurekaindia.com , [15.6],
31	**Eureka Forbes** https://www.forbesprocleaningsolutions.com, [23.22], [49.1],
32	**Euronics Industries Pvt Ltd**, 567-566, Udyog Vihar, Phase - 5, Gurugram 122016, www.euronics.co.in, [23.8], [23.14], [23.18], [23.23],
33	**Evoqua Water Technologies India Private Limited**, DLF IT SEZ Park, Block 8, 5th Floor,, No: 1/124 Mount Poonamallee Road, Manapakkam, Chennai 600089 India.+91 44 6136 3100, sales.in@evoqua.com, [49.1, [49.3],
34	**Ezytek Clean**, G-137,Sector-63, Noida, www.ezytekclean.com, [23.22], [23.20],
35	**Finale Machinefabriek,** A11/1/13, MIDC Area, Ahmednagar 414 111, India. +91 9423006250, +91 9422226250 Telefax +91 241 2422343, finale_engineering@yahoo.com, [41.2], [43.1],
36	**Frick India Limited**, Ion House, 3rd Floor, Dr E. Moses Road, Mumbai 400011,+91 24924687, +91 24925203, Fax +91 24935552, mumbai@frickmail.com, www.frickweb.com. M Sudhir Kumar, [37.1], [37.4], [37.10],
37	**Giordano Poultry-Plast SPA**, Via Bernezzo 47, 12023 Caraglio CN, Italy, info@poultryplast.com, www.poultryplast.com, [13.1],
38	**Guntner Middle East FZE,** Arun K. Bhatia, +971 4 371 2830, +971 56 219 3335, +971 56 118 2260, a.bhatia@guentner.com, akbhatia007@hotmail.com, [37.3],
39	**Haarslev Industries, A/S,** Bogensevej 85, DK-5471 Søndersø, +45 63 83 1100, Praveen K. Bhagat, +91 77739 22797, praveen.bhagat@haarslev.com, info@haarslev.com, www.haarslev.com, [41.2],
40	**Heat and Control India**, 99 E-2, 3rd Avenue, Anna Nagar East, Chennai, India. 600102, +91 44-42103949, 91 44-26212943, +91 98412 80830, info@heatandcontrol.com, [11.1], [11.2], [33.1], [29.13], [51.2], [51.4],
41	**Hindustan Dorr-Oliver Ltd**, Dorr Oliver House, Chakala, Andheri (East), Mumbai 400099, India. +91-22-28359400 Fax: +91-22-28365659, hdoho@hdo.in, marketing@hdo.in, www.hdo.in, [49.1], [49.3],
42	**Icepack Marketing Company**, B-325, Sarita Vihar, New Delhi 19- 044, 011 6949230, e. mail **agochiya@vsnl.com**, [17.5], [37.6],

43	**IFB Industries Limited** 2, Plot No. IND-5, Sector-1, East Kolkata, Kolkata, India - 700107. +91 1860 208 5678 1860 425 5678, [27.1], [27.2], [33.2],
44	**Indian Broilers,** National Highway 6, Indamara, Rajnandgaon , Chhattisgarh 491441, India. +91 7744-224069, +91 7744-226175, www.ibgroup.co.in, [41.1],
45	**Indian Dairy Machinery Company Limited**, (National Dairy Development Board), Anand - 388 001, Gujarat, India +91-2692-260148, +2692 260149, +91 2692 260159, +91 2692 260160, Fax: 91-2692-260157, anand@nddb.coop, [37.1], [37.10], [33.2],
46	**Ingersoll Rand (India) Limited,** First Floor Subramanya Arcade No 12/1 Bannerghatta Road Bangalore – India. + 91-80-46855100, [7.1],
47	**Intralox India Pvt Ltd**, No 18/23, Peenya 1st Stage, Phase -1, Peenya, Bengaluru, Karnataka 560058, India. +91 90084 88116, Kartikeyan K, Kartikeyan.K@Intralox.com, www.intralox.com, [11.1], [11.2],
48	**Industrial Refrigeration Pvt. Ltd,** 901, Maker Chambers V, Nariman Point, Mumbai - 400 021, India, +91 22-489-31805 Contact for systems with Grasso compressors. They also represent Geneglace range of FrigoFrance S.A. [37.1], 37.10], [37.4], [37.5],
49	**Ishida India Pvt Ltd** 382, Ground Floor, Udyog Vihar II, Gurgaon 122016, India. 0124 484 4391. Jiro Hatakeyama, MD. +91 97177 91451. [29.13], [29.2], [29.3], [29.5], [51.2], [51.4],
50	**Jarvis Equipment Pvt. Ltd,** Plot 93A, Sector 5 – IMT Manesar, Gurgaon, Haryana 122050, India. +91 124 416 4100 sales@jarvis.co.in. Semi-automatic tools, further Processing Equipment[33.1], [35.1],
51	**John Bean Technologies (JBT),** Dehu - Alandi Rd, MIDC, Moshi, Pimpri-Chinchwad, Maharashtra 412105, India +91 70105 56015, www.jbtc.com, [37.11], [33.1], [33.2],
52	**J. D. Engineering** Bhorgarhi Ind area, Dasna. Hapur Road, Ghaziabad, India. +91 97110 04841, +91 98730 09691, subodhtyagi123@gmail.com, subodh@jdengineering.in, [41.2], [43.1],
53	**Join Pack Machines (Pvt) Ltd**, 19/21, Shakti Nagar, Delhi - 110007, India, +918037301643, Fax : 91-11-42351892, Sanjeev S Arora (Director)+ 918037301643 , [29.17],
54	**Kärcher** 275 Pendant Drive Mississauga, ON L5T 2W9, www.kaercher.com/ca [23.9],
55	**Khosla Compressors Ltd,** 1, Desh Bandhu Gupta Road, New Delhi, 110055 India. +91 9810700331, info@kgkhosla.com, [7.1],
56	**Kingspan Jindal,** Old Manesar Road, Narsinghpur, Gurugram, Haryana 122004, India. +91 124 4393200, +91 7065 275454, sales@kingspanjindal.com, www.kingspanjindal.com, [37.8],
57	**Kirloskar Pneumatic Co Ltd**, Plot No.1, Hadapsar Industrial Estate, Pune- 411 013, Maharashtra, India. +91 020 26727000, Fax : +91 (20) 2687 0297, infokpcl@kirloskar.com, www.kirloskarpneumatic.com, www.kirloskars.com, [45.6], [35.9], [7.1],
58	**Knecht Maschinenbau GmbH,** 88368 Bergatreute Witschwinder Strasse, 26, West Germany, 07527/928-0, Fax 07527/928-32, [35.13],
59	**Lark Engineering,** I.T.I, Sasoli Road, Jagadhri Workshop, Yamuna Nagar, Haryana-135002. India +91-92154 59685, sales@larkenggco.com, [31.2], [31.1], [43.1],
60	**Lipsia JSC, St. Petersburg,** Krasnogvardeyskiy lane, 23E, 197342, St. Petersburg, P.O. Box 15, St. Petersburg, Russia, 197342, +7 (812) 777-72-17, Fax 8 (800) 333-72-17, , info@lipsia.ru, www.lipsia.ru, [37.9], [11.2], [11.3],
61	**Lloyds Insulation (India) Ltd**, Plot no 2, Punj Sons Premises, Kalkaji Industrial Area, Kalkaji, New Delhi – 110019, India. +91 011 – 30882900, lloyd@del2.vsnl.net.in, www.lloydinsulations.com, [37.8], [37.12], [37.13],
62	**Manmachine (India) Private Limited**, E-98, Sector 6, Noida 201301, www.manmachineindia.com, [23.9],
63	**Marel,** +91 99161 51970, josemartinxavier@gmail.com, Jose Martin Xavier, Area Sales Manager, jose.martin.xavier@marel.com [31.1], [33.1],
64	**Mavitec** Galileistraat 20, 1704 SE „ Heerhugowaard, The Netherlands hdamen@mavitec.com, Sujit Kumar +91 98318 69406, +91 99038 50331, +91 33-23594076, +91 70047 66939, sujit@sujitskumar.com, sujit.metrochicken@gmail.com, sujit@sujitskumar.com [41.2],
65	**Meyn India P. Ltd,** 539 Stellar Business Park, Plot 03, Tech Zone, Greater Noida 201310, U.P. India. +91 +91 88603 29800, msingh@meyn.com, Mukanjay Singh. [31.1],
66	**Mitzvah Commercial & Industrial Air Curtain Manufacturer**, Noida One, Mitzvah - C 1111, Block B, Industrial Area, Sector 62, Noida, Uttar Pradesh 201309, www.mitzvah.in, [47.1],
67	**M. K. Juchheim GmbH & Co (Jumo) ,** 36035 Fulda, Germany, (06 61) 60 03-0, Fax (060 61) 60 03-6 07, mail@jumo.net, www.jumo.de, [45.3],
68	**Multivac** Laraon India Private Limited Manesar, Gurugram, Haryana, India. [29.13], [51.2],
69	**Nijhuis Industries**, Innovatieweg 4, 7007 CD Doetinchem, P.O. Box 44, 7000 AA Doetinchem, The Netherlands. +31 314 749 000, +31 314 749 049, +31 314 749 059, service@nijhuisindustries.com, www.nijhuisindustries.com, [49.4], 49.1], [49.3],
70	**Nieros Metal Tovarna Opreme d.o.o**., Slovenj Gradec, Gmajna 55, 2380 Slovenj Gradec. www. nieros.com, [23.8], [23.11], [23.3], [23.14], 23.23], [23.24],
71	**Nilkamal Ltd. Nilkamal House,** Plot 77/78, Street number 14, M.I.D.C. Andheri East, Mumbai - 400093, https://nilkamal.com/material-handling/, For Material Handling / Industrial Products:marketing@nilkamal.com, [13.2], [13.3]
72	**Nirmal Automation Pvt Ltd,** Paud Rd, Lokmanya Colony, Kothrud, Pune, Maharashtra 411038, India. +91 8048764047 [15.10], [15.18], [15.1], [15.2], [15.3],
73	**Pedigree** 1-800-525-5273, www.pedigree.com, [41.1],

74	**Pharmafoods Ltd,** Carrickbeg, Carrick on Suir Co. Tipperary, Ireland**,** 353 51 645066, 353 51 645084, Fax: 353 51 645066, **info@pharmafoods.net**, [35.1], [35.6],
75	**Praj Refrigeration Industries,** A/203, Durvankur Society, Nagar Mundhwa Bypass, Kharadi, Pune 411 014, Maharashtra India. +91 20 65249542, +91 20 65343794, Fax +91 2027010044, +91 9890146817, priflake@gmail.com, **priflake@vsnl.net**, [37.5],
76	**Praxair India Private Limited**, Mercury 2B Block, 6th. Floor, Prestige Technology Park, Outer Ring Road, Marathahalli, Bangalore - 560 103, India. +91 80 3069 1000 – 03, Fax +91 80 2844 0156, www.praxair.co.in [37.6], [37.14], [37.2],
77	**Ramky Enviro Engineers Ltd**, Ramky Grandiose–12th & 13th Floors, Ramky Towers Complex, Gachibowli, Hyderabad-500 032, Telangana, India. +9140-23015000, Fax : +91-040-23302353, reelinfo@ramky.com, https.ramkyenviroengineers.com, [49.1], [49.3],
78	**Redox Water Technology B. V.** Stevinstraat 11, 7102 DZ Winterswijk, Netherlands. +31 543 531 030, +31 (0)543-519089, info@redox.nl, www.redox.nl [49.1], [49.3],
79	**Rinac India Ltd,** No.-5, Saraswathi Nivas, Main Channel Road, Ulsoor, Bangalore -560008, India. +91 1800 4 252, +91 9916042420, rilco@rinac.com , www.rinac.com [37.1], [37.4], [37.8], [37.10],
80	**RND Practical Engineering**, SR No. 41/2/1/2, Yewalewadi Road, Badhe Nagar, Behind Silver Hall, Opposite Angraj Dhaba, Kondhwa, Pune-411048. +91 80487 64427, Lawrence DuBois, [31.3], [31.4], [31.1], [31.2],
81	**Rittal India Pvt. Ltd.,** Nos. 23 & 24 KIADB, Industrial Area Veerapura, 561203 Doddaballapur, Bengaluru District, Karnataka, India, +91 80-61413900, +91 80-61414063, Fax: +91 80 61414900, info@rittal-india.com, www.rittal.com, [9.1],
82	**Robot Pumps B.V.,** Produktieweg 5**,** P.O. Box 140**,** 2400 AC Alphen aan den Rijn, The Netherlands +31 172 418686, Fax: +31 172 418602, robot.pumps@metso.com, www.robotpumps.com , [35.11],
83	**Sabroe Refrigeration/York Refrigeration India Ltd/Johnson Controls**. www.johnsoncontrols.com, www.york.com, [37.10],
84	**Safeline Ltd**, Montford Court, Salford M5 2SN, England, 061 848 8636, Fax 061 848 8595, [31.5],
85	**SEW-Eurodrive India Private Limited**, Plot No.4, GIDC Por, Ramangamdi, Vadodara-391 243, Gujarat, India. +91 265 3045200, marketing@seweurodriveindia.com, www.seweurodriveindia.com, [9.2],
86	**SGS India Ltd**, 250 Udyog Vihar, Phase IV, Gurugram 122 015 E. India. www.sgsgroup.in, , [3.1], [3.2],
87	**Sico House**, Swastik Compound, Chincholi Bunder Road, Ram Bagh, Malad (West), Mumbai, Maharashtra 400064, +91 22 2882 1123, [23.18],
88	**Star Metal Forms Pvt. Ltd**., 162, G.I.D.C. Estate, Opp. Pandesara Post Office, Pandesara, Surat, Gujarat - 394221, India. +91- 261- 2891875, sales@diamondflushdoors.com, [15.1], [15.2], [15.3], [15.11], [15.7], [15.12],
89	**Stefab India Limited**, 39/14, Netaji Subhash Industrial Area,, Tikri Kalan, Rohtak Road, New Delhi 110041, India. +91-98112 85702 +91-98112 85712, corp@stefab.com, sales@stefab.com, www.stefab.com, [27.1], [27.2],
90	**Storm Engineering India P Ltd**, 220, Ganesh Nagar, At Post: Kesnand, Tal Haveli, Dist Pune 412207, +91-+91 73500 36801, +91 88888 99128, salesstormindia@gmail.com, Prakash Sansare [23.8], [23.23], [23.4], [31.1], [31.2], [31.3], [31.4]
91	**Swastik Enterprises** D. No 89-18-50, Morampudi Junction, Rajahmundry, Andhra Pradesh, India. +91 883 463658, +91 883 467265, swastik_entp@hotmail.com , [35.12], [43.1],
92	**Systems & Components Ltd**, 110-111, Gautam Udyog Bhavan, L B S Marg, Bhandup West, opp. Ishwar Nagar Post office, Mumbai, Maharashtra 400078, India. +91 22 2594 7557, info@syscomp.co.in, [37.1], [37.4], [37.10],
93	**Taejin Machinery Co Ltd**, Plant #832, Dukdo-Ri, Kwangjuk-Myun, Yangju-Gun, Lyunggi, Korea. Seoul Office #698-4, Chongnung 3 Dong Sungbuk-Gu, Seoul, Korea, Tel 82-2-918-1336/8, 82 - 31 – 8719001, Fax: 82-2-918-1339, 82 - 31 – 8719005, taejin@kotranet.kotra.co.kr, master@taejin.koreasme.org, [31.1],
94	**Taifun Engineering OY Ltd**, Bedrijvenpark Twente 305, 7602 KL Almelo, The Netherlands, +31 546 549 255, Fax +31 546 549 257, info@taifun.fi, [45.7],
95	**Thermax Ltd**, Thermax House, 14 Mumbai Pune Road, Wakdewadi, Pune 411003, India. www.thermaxindia.com, www.thermaxglobal.com, [5.1], [5.2], [49.1], [49.3],
96	**Tremco CPG (India) Private Limited (Flowcrete India),** Perambakkam High Road, Mannur Village, Sriperumbudur Taluk, Kancheepuram District, Pin 602105, India +91 44 4017 6600, indweb@flowcrete.com, [19.4],
97	**Voltas Limited**. Voltas House 'A' Block, Dr. Babasaheb Ambedkar Road, Chinchpokli, Mumbai - 400 033, India. +91 22 6665 6666, www.voltas.com, [37.4], [37.10],
98	**3M India Ltd**, Plot No 48-51 Electronics City, Hosur Road,Bangalore,Karnataka-560100 Ph: 91-80-22231414, E-mail: vsrinivasan@mmm.com, URL: http://www.3m.com/in, 91-80-22231414, [29.1], [29.4], [29.7], [29.12], [29.14], [29.16],

Readers are welcome to send their comments, critiques, observations and suggestions to the author at rajalok@gmail.com. The author gratefully acknowledges valuable information inputs from various industry professionals.

Endnotes:

[i] Caris Pure assumed that shipments of unpacked carcasses to hotels and restaurants merely replaced wet market supplies and was therefore not subject to GST under the TNVAT Act 2006 Entry 54 of Part B of Schedule IV Section 15. Just as, according to his claim, other processors were exempt. But was compelled to comply with the tax assessment orders passed in respect of the assessment years 2014-15 and 2015-16. Source: *Indian Kanoon* http://indiankanoon.org/doc/121070941/

[ii] EnergyForums.net https://energyforums.net/hvac/how-humidity-affects-heating-and-cooling/.

[iii] If the explanations in figure 1 do not convince you, perform this thought experiment:
Ask a friend to stand in a street of Mumbai at the same time that you stand 100 km east somewhere on the plains in Maharashtra. Do this on a cloudless summer day. Now take the temperature of the air. Mumbai will report 36°C and the inland location will report 41°C. The same sun is heating air in both locations Why this difference? The answer is that the sun has to heat a whole lot of moisture coming from the sea in Mumbai while the inland location it is heating relatively dry air. Remember water or water vapour has a much higher thermal mass that dry air. What goes for heating air also goes for cooling air.

[iv] Watch Richard Feynman's lecture "There's Plenty of Room at the Bottom" in https://www.youtube.com/watch?v=4eRCygdW--c, titled. Feynman, who received the Nobel prize for quantum electrodynamics, set the scene for development of nanotechnology with these concepts. It will also help you understand the nature of interaction between microbes and their environment

[v] Schmitt, 2000, as quoted in Clean Air Solutions in Food Processing.

[vi] Source: CLEAN AIR SOLUTIONS IN FOOD PROCESSING - This literature review has been written by Gun Wirtanen, Hanna Miettinen, Liisa Vanne, Seppo Enbom and Satu Pahkala.

[vii] A number of reasons can cause wrong air movement with department-wise extraction arrangements. For instance you can create a net negative or net positive pressure in any given chamber at a time, depending on (1) variations in installed fan capacities, brands or sizes, (2) differential external wind load on any one side of the building, (3) mismatch between opened doors along the two sides of the building, (4) failure or downtime of one or more fans, (5) difference among fans in reaching desired RPM, (6) obstruction through differential deposition of dirt in fan blades and cowlings or (7) wrong or delayed sequencing of startup of the fans, often depending on the condition and rating of capacitors or state of lubrication in the bearings. Remember, electrolytic capacitors, used in cross ventilation fans, age over time and their rating changes substantially, largely depending on their operating temperature and brand.

[viii] Ventilation of Poultry Slaughtering and Processing Plants by Heber, Zimmerman and Linton. This article was posted by Cooperative Extension work in Agriculture and Home Economics, state of Indiana, Purdue University, and U.S. Department of Agriculture Cooperating, in furtherance of the acts of May 8 and June 30, 1914.

[ix] At a typical food-processing plant, undesirable air is exhausted to the outdoors. Unfortunately, part of the discharged air often stays in the air-foil of the building, setting up a scenario in which exhausted contamination can partly re-enter the plant at another location. Roof exhaust stacks from heavily contaminated areas that do not have HEPA filters need to be high enough so that none of the exhausted air can be re-entrained. Exhaust stacks should be 1.3 to 2.0 times the height of the building, including any parapet or other roof equipment. Stronger winds increase the need for taller exhaust stacks. Source: ibid, CLEAN AIR SOLUTIONS IN FOOD PROCESSING