Pasta “al dente”

Robert Hilfiker

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Pneumofore

Life cycle cost: we always win

Pasta "al dente"

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***W**hat role does vacuum play in the production of pasta?*

***T**he influx of high vacuum on the quality of pasta.*

***E**ssential, simple and long lasting solutions.*

Nowadays, pasta has become a truly global food, found all over the world.
Everybody loves a nice dish of pasta: it's easy to prepare, easy to digest and combines perfectly with a wide variety of sauces and cooking styles.
Pasta is an essential part of the low calorie Mediterranean diet. Spaghetti, made of "slow" carbohydrates, supplies our body with nutritional energy evenly distributed over several hours.
Italy exports 40% of its nearly 3 million-ton annual production, which represents almost a third of the world's total pasta production.
The pasta production cycle starts with the mixing of flour and water inside a large basin. From there, it is poured into a second container with a rotating Archimedes' screw, and finally into a third basin where, a few moments before extrusion, vacuum reduces the humidity of the dough.

Fig. 2 - Pneumofore UV16 vacuum pump at Italpasta - Torino

Vacuum %	Absolute pressure mbar	Evaporation H_2O °C	Spec. vol. H_2O vapor m^3/l
Atm. condit.	1000	100°C	/
70	300	69	4,6
80	200	60	7,7
90	100	46	14,5
95	50	33	28
97	30	24	45

Fig. 1 - Data on water evaporation, with the application of vacuum

Physics teaches us that while water usually transforms into vapor at 100 °C, evaporation occurs at lower temperatures under diminished atmospheric pressure. A typical schoolbook example uses the experience of mountaineers: on top of Mont Blanc, at 4810 meters, water boils at 80°C.
This phenomenon can be clearly understood in a table showing the influence of vacuum degree on evaporation and, hence, on relative humidity content (Fig.1).
The production of high quality pasta requires pumps able to produce 95% vacuum, with absolute pressure of 50 mbar. Many pasta factories have found that higher degrees of vacuum guarantee higher product quality.
Pumps powerful enough to evacuate the necessary 10 to over 30 grams of water per hour can generate high maintenance costs. Pneumofore's UV series pumps operate at 100 °C, thus preventing formation of condensate and expelling the evacuated water as vapor. An apposite in-built filter eliminates all traces of oil from the expelled vapor.
At one time, pasta-manufacturing factories used water-cooled rotary vane or piston-type vacuum pumps. Now these older models are gradually being replaced with pumps using liquid-ring, screw and air-cooled rotary vane technologies.
Since each of the newer types is used for specific applications, none of these newer pumps has clear priority over the others. However, when the need is to produce spaghetti that can successfully undergo the cooking process, it is clear there are a few "Conditio sine qua non" (Latin for "Essential conditions"):

- Durum wheat must be used for the production of spaghetti
- Short cooking time cannot always guarantee spaghetti "al dente" if the raw product is of inferior quality
- To ensure maximum quality, the maximum amount of humidity must be extracted from the pasta during production.

To put it simply, spaghetti with less humidity

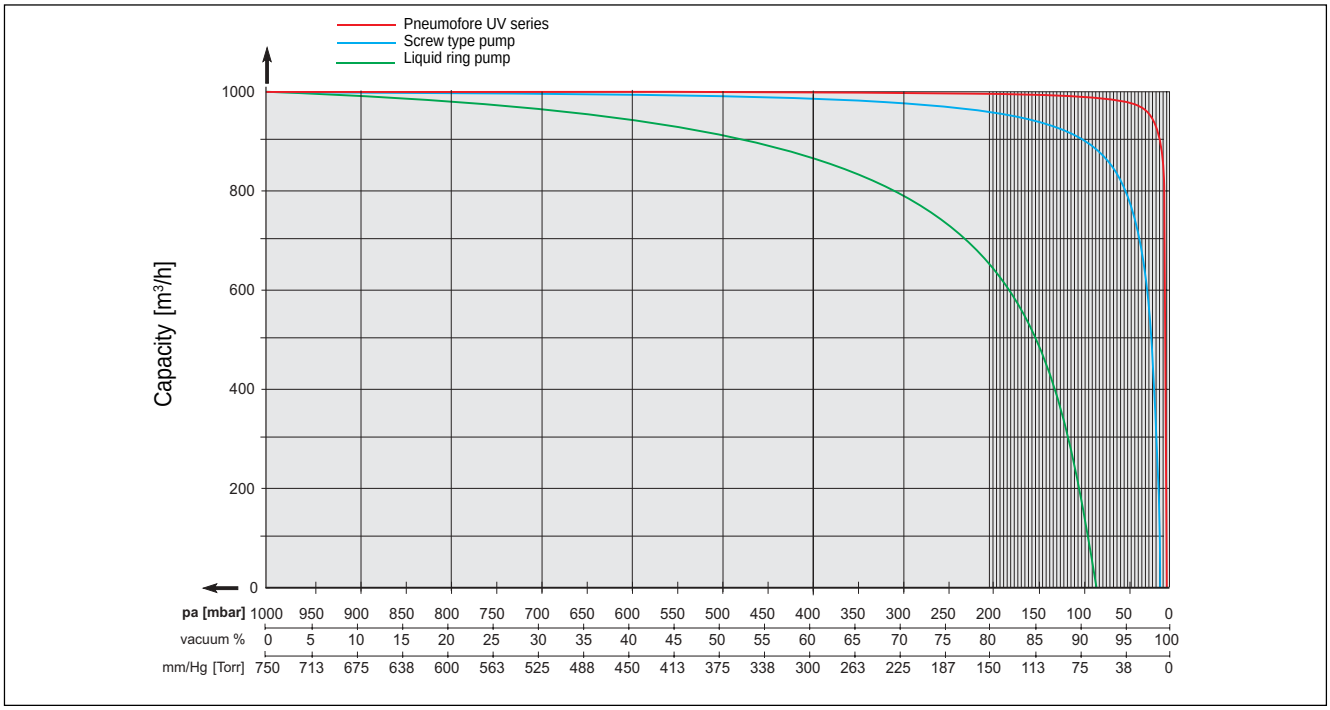


Fig. 3 - Data on capacity of vacuum pumps with changes in vacuum degree (absolute pressure)

cooks better. Moreover, the product has a shiny surface which looks more appetizing to the consumer.
The following two diagrams illustrate the solution to this humidity problem provided by Pneumofore's UV Series pumps.
Fig.3 shows a complete diagram indicating the vacuum rate of the three main pump types currently in use.

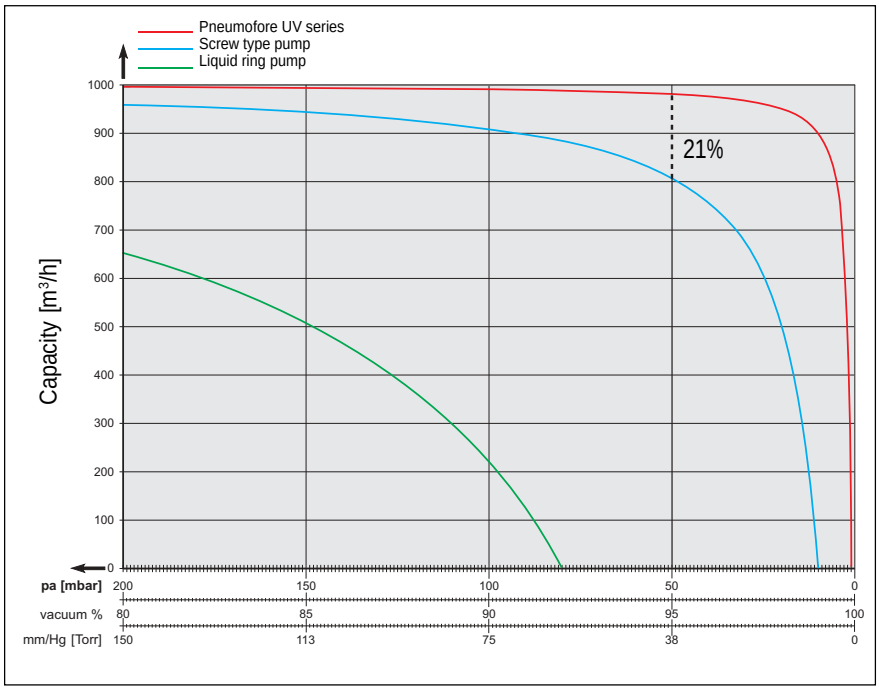
- The red line corresponds to the rate of intake volume of new Pneumofore UV vacuum units (abs. press. 2 mbar).
- The blue line represents the same rate using old water-cooled Pneumofore UV type rotary vanes and new screw pumps (absolute pressure 10 mbar).
- Oil liquid ring pumps (green line) give the worst results, generating an absolute pressure of 80 mbar, and with performances that vary in relation to oil temperature.

The enlarged portion of this diagram covering absolute pressure over 200 mbar, highlights the beneficial effects on the quality of the pasta (Fig.4).
Here too, the red line indicates the volumetric capacity rate of new air-cooled UV vacuum units with oil injection, with absolute pressure of 2 mbar.
At an absolute pressure of 50 mbar (the basic condition for the production of high quality spaghetti), Pneumofore UV pumps suck 21% more volume than other single-stage pumps, therefore allowing the use of pumps with lower capacity.
Pumps with oil liquid rings are also often used to avoid condensate, but in this case, there are two great user inconveniences:

- Electrical energy consumption is 40% higher
- Maximum achievable vacuum is 92%

What happens to water vapor inside pumps with closed oil circuits?
UV units for pasta factories work at higher temperatures, no condensate is created in the oil circuit of the vacuum pump, and the humidity becomes vapor, which is finally expelled into the atmosphere, with no traces of oil.
UV Series pumps guarantee production of more vacuum, producing spaghetti of higher quality and less risk of overcooking.

Fig. 4 - Zoom into the 200 mbar range section of Fig. 3



Case history 1

To illustrate our point we can look at the Italpasta factory in La Loggia, near Torino, where a model UV16 vacuum unit successfully replaced two old Pneumofore V45 vacuum pumps, which had been in use for over 30 years. Thanks to the characteristics of the UV16 pump, an increase in vacuum degree was obtained, reaching 95%, with great energy saving (the electric power absorbed being only 17 kW per 940m^3/h of intake volume).
Furthermore, with the environmental advantages of air-cooling and almost nil oil consumption, the UV Series demonstrates great respect for nature.
Low noise level and the absence of noxious exhausts made it possible to install the pump inside the production area, further reducing installation costs.

Case history 2

Success was also achieved in another important Italian pasta factory where Pneumofore's UV16 pump replaced a different type of pump, with excellent results. Previously, four piston pumps had been installed; the normal production rate involved the simultaneous use of three of them, with power consumption of 50 kW.
The installation of Pneumofore's UV16 pump reduced the amount of power used to 30 kW.
Considering approximately 7000 hours of operation per year, with a cost of 200 ITL/kWh, the R.O.I. point is reached in 13 months.

All of Pneumofore's UV vacuum pumps have their own cabin, with every component on board, and installed ready for use.
The change from water-cooling to air-cooling system is based on ecological concepts.
The continuous growth in the price of water suggests the need to diminish its use in industrial plants.
Air-cooling systems are extremely adaptable to the thermostatic management of pumps.

Fig. 5 - Italpasta factory - Torino

Deriving from Pneumofore's 8 bar compressors, UV pumps are long lasting, need no vane substitution, and only the oil needs changing after 3000-5000 hours of operation.

The success of UV pumps is due to their unbeatable reliability and to their efficient solution of the common problem of oil vapor pollution of the atmosphere.
Yet another field where Pneumofore pumps are innovative.

Robert Hilfiker was trained as an engineer at ETHZ (Swiss Federal Institute of Technology) in Zurich and completed an apprenticeship abroad before joining Pneumofore, the company his father founded in Turin, Italy, in 1923. As Managing Director of Pneumofore, Mr. Hilfiker has led our company to growth and success for over 40 years. He is now Chairman of Pneumofore in Turin.

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Pneumofore SpA - Via N. Bruno, 34 - 10090 Rivoli (Torino) - Italy
Tel. +39 011.950.40.30 e-mail: info@pneumofore.com
Fax +39 011.950.40.40 http://www.pneumofore.com