The future of hatchery technology

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There can be few better examples of a fusion between scientific advancement and the demands of modern customers than the latter day hatchery.

Today's hatchery is a super clean, efficient, technologically driven environment, designed to recreate the optimum scenario for sound embryonic development and huge numbers of healthy, day old chicks.

Yet with the rapid pace of change and the ever increasing economic demands that are being placed upon them, even these modern hatcheries face three serious challenges to their continued growth and profitability in the future:

- **Genetic progress.**

Brings with it increasing pressure to deliver optimum environmental management, not only to meet the needs of today's modern breeds, but also to keep abreast of genetic advancement for the next 20 years and beyond.

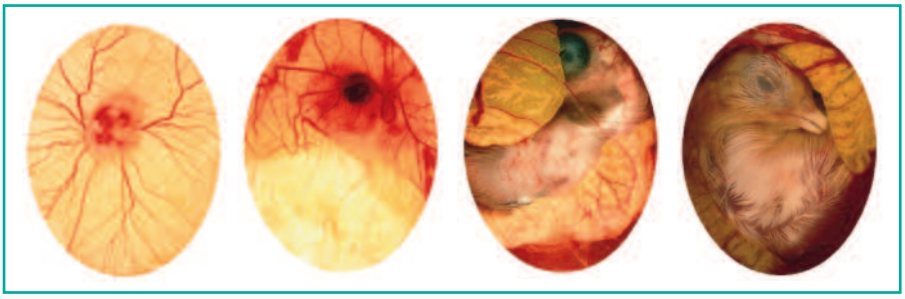
SmartSet setter.

- **Uniformity.**

The golden egg of poultry production. Achieving ever higher levels of day old chick uniformity in terms of physical appearance is already a significant prerequisite to hatchery performance.

- **Post hatch performance.**

A natural result of high uniformity, the achievement of outstanding post hatch technical results relies on the ability to deliver optimum results on feed conversion, liveability, yield and egg production.



To define the hatchery of the future is a multi-faceted task. Pas Reform has invested in the co-operation of embryologists, poultry integration experts, hatchery management specialists, electro-mechanical engineers and industrial designers, to focus solely on these three key challenges.

Genetic progress

Genetic selection and highly evolved management practices have dramatically improved poultry meat and egg production. In modern broilers, for example, the growing chick spends half the time on the farm than it did a little over 25 years ago.

The rearing period has decreased since the late 1980s from 84 days to just 42 today. Similarly, whereas in the past chicks spent just 20% of their total lifespan, from egg to slaughterhouse, in incubation, today's modern broiler breeds now spend 33% of their lives in the incubator. While less time in rearing has reduced the overall cost of inputs for the growing broiler.

It is also clear that quality and performance in the incubation of the embryo has a fundamental and dramatic impact on the growth performance and feed conversion ratios of modern birds.

For that reason, incubation plays a vital role in determining commercial breed performance. It is not just the proportion of lifetime spent in the incubator that has changed. Research has proven that each modern breed generates its own unique metabolic heat signature in the egg.

This is hugely significant to achieving healthy embryonic development – and a factor that fully advocates the adoption of single-stage incubation, to cater for the different needs of emerging modern breeds in the future.

Genetic selection for high post natal growth has fundamentally changed the pattern of embryonic development and rates of biosynthesis (growth), resulting in ever higher levels of metabolic heat production, that must be carefully managed in the incubator to achieve optimum hatchability and uniformity.

For example, metabolic heat production in Ross 308 birds has been shown to have increased by 26% over recent decades, when compared to the traditional breed 'North Holland Blue'.

This is a feature that will become more pre-eminent in the future and one that can only be fully optimised by a system that provides breed and age specific incubation environments.

Such accurate and sensitive management

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Table 1. Field data hatch performance (2005/2006). Homogeneous incubation conditions lead to better hatchability results and markedly reduced production costs of day old broilers.

	Multi stage incubation	Pas Reform single stage incubation	Difference
Hatchability (%)	78.6	81.2	2.6
Costs/day old chicks ($)	0.277	0.233	0.044
No. of day old chicks produced	14,100,000	18,900,000	

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of embryonic temperature is only achievable in a modular single stage incubation environment that provides homogeneous temperature distribution.

High uniformity

High uniformity in day old chicks is one of the greatest challenges facing commercial hatcheries. Yet synchronising the hatch as closely as genetically possible is feasible with the knowledge we have at our disposal today.

Uniformity is a feature of synchronisation – starting the incubation process in a batch simultaneously, with a rapid and uniform increase in eggshell temperature towards set point, will achieve a uniform start to embryonic development.

Failure to optimise homogeneous temperature distribution to the specific requirements of each egg will cause the embryos to grow at different rates, resulting in large variations in the development or maturation of day old chicks at the point of hatching and a large spread of hatch.

Failure to manage eggshell temperature homogeneously and accurately for each egg is proven to have highly detrimental effects on uniformity and further, to significantly undermine subsequent post hatch performance.

Hatchery managers are beginning to understand that it is possible to actively manage the embryo while in ovo. Modular single stage incubation fully maximises hatchability and chick quality – because temperature, humidity and ventilation can be finely adjusted to the needs of each breed, embryonic age and batch. In this way, flock uniformity is steered by the shortest possible spread of hatch.

Post hatch performance

It is now widely accepted that homogenous conditions result in the shortest spread of hatch to give high levels of uniformity and the fullest expression of genetic potential.

Good uniformity of day old chicks is so highly prized, because it dramatically improves technical results at farm level, including the lowest feed conversion and mortality rates, the fastest growth rates and excellent processing yield and egg production (Table 2).

Defining the future

Pas Reform has a long standing track record for innovation in the development of hatchery technologies.

Over the past three years, the company has dedicated substantial resources to working closely with a range of specialists, in a major research and development project to design an incubation system that successfully and reliably meets the three key challenges facing hatcheries in the future.

The result of these investigations is the design and development of Smart, the next generation incubation system that not only meets these challenges in today's terms, but forecasts the emergence of new parameters and trends to future proof the Smart system.

Smart enables the hatchery to fully realise the benefits of genetic advancement, with the capacity to cater for the incubation requirements of specific and individual breeds for at least the next 20 years.

High chick uniformity is reliable and consistent, due to modular design and unique control systems – and as a natural result of genetic optimisation, every key performance indicator, from uniformity to processing yields is significantly improved.

SmartHatch hatcher.

Thinking ahead

Pas Reform has been at the forefront of single stage incubation technology for the past 35 years.

Building on the tried and trusted success of its existing systems, Pas Reform's new Smart incubation system takes established principles a stage further, to fully maximise the benefits of homogenous temperature control as the single most important criteria for success in rearing modern breeds and their future offspring.

At its core, Smart incubation embraces the ability to actively manage the developing embryo while it is still in the egg.

The modular design and total control over every operating parameter means that a diverse range of incubation environments can be created and managed at any one time, to meet the breed specific needs of the growing embryo.

The full Smart incubation system comprises SmartSet (setter) and SmartHatch (hatcher), combined with the SmartDrive incubator control system, to allow for the careful management of individual conditions per egg type and SmartCenter, a powerful hatchery management information system.

Unique signature

As we have seen, homogenous temperature distribution is the single most important parameter for successfully incubating today's modern breeds, each of which has a unique temperature 'signature' for embryonic development.

Even minor temperature fluctuations can have a major impact on uniformity and post hatch performance. With SmartSet, the average difference in eggshell temperature is less than 0.5°F.

Its modular design meets this specific requirement by enabling set points to be defined separately for each section of 19,200 hen eggs – and this allows for both single stage (all in/all out) and multi-stage incubation.

With capacities up to 115,200 hen eggs, SmartSet is the largest closed door, single stage incubator available on the market today.

Once the trolleys are in, total system control is possible from outside the setter, eliminating any need to move trolleys during the setting period and fully preserving the integrity of heat management and distribution.

Features include:

- **Increased heating capacity.**

To improve day old chick uniformity, it is vital that the hatching eggs, once in the setter, are rapidly and evenly brought on temperature to start the incubation process. SmartSet's new heating device has a substantially larger heating surface area and therefore reduces the time to reach machine set point by 50%. This significantly improves uniformity and subsequent post hatch performance

- **Increased cooling capacity.**

Modern breeds generate more metabolic heat now than in the past – and detailed work to forecast future developments has enabled Pas Reform to calculate cooling capacities not only for today's breeds, but also for their offspring in 20 years from now. In SmartSet, cooling capacity has been increased by 40%.

- **Integrated heating and cooling system.**

To achieve homogeneous temperature distribution throughout the machine, SmartSet has a combined heating and cooling device with 34 vertical, parallel coils per section,

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supplied with hot or cold water for optimum energy transmission to and from the incubating eggs.

No human intervention

To deliver a fully automated hatching system that delivers accurately regulated temperature, humidity and ventilation. Pas Reform has developed SmartHatch, an exemplary hatcher that delivers high day old chick uniformity with no need for human intervention. Features include:

- **Optimised cooling system.**

Thanks to a detailed understanding of the impact of metabolic heat production on the growing embryo, Pas Reform has calculated the cooling capacities for SmartHatch not only for today's breeds, but also for projected breed requirements in 20 years from now.

SmartHatch incorporates 12 parallel cooling circuits that surround the incubating eggs (SurroundCooling), to deliver an added 20% cooling capacity. The circuits are fully integrated into the aluminium cabinet panels to massively increase the cooling surface area for even temperature distribution.

SmartDrive incubator control.

- **Automated hatching system.**

Fully automated processes deliver greater accuracy and SmartHatch monitors and adjusts the hatching process automatically from the day of transfer through to the last chicks hatching, eliminating any need for human intervention. Field trials have proven that the systematic measurement and control of temperature, humidity and carbon dioxide production, combined with the use of current and historical data to adjust the hatcher environment automatically consistently produce high levels of uniformity per batch.

- **Hygiene.**

SmartHatch is constructed of high quality, smooth-walled 'food safe' anodised aluminium, stainless steel and polystyrene. Its robust cabinets are resistant to strong disinfectants and corrosion and extremely durable. The absence of closed air ducts improves hygiene and sanitation, while the incorporation of the cooling circuits into the walls greatly reduces cleaning time.

Controlling every function

SmartDrive delivers total control over every function and setting within each, individual incubator, from humidity and carbon dioxide levels and the position of air inlet valves, to the individual operating parameters – temperature, heating, cooling, ventilation and turning – required per batch/egg type.

Ergonomic design and the use of clear, full colour TFT displays and icons, allow SmartDrive to be configured quickly and simply to programme incubation conditions to meet breed specific requirements.

Features include:

- **Pre-heat function.**

To improve day old chick uniformity requires a synchronised start to incubation. It is critical that the hatching eggs are heated quickly and uniformly once placed in the setter and Smart- Drive's pre-heat function takes this one step further. Full programming for pre-heating time, temperature and ventilation allows the time needed to reach a specific set point from start up to be reduced even further.

- **New PID control combined with set points per section.**

SmartDrive incorporates the latest version of PID (Proportional Integral Derivative) control, enabling the hatchery to simulate optimum (near natural) incubation set points to minimise overshoots. The new PID control is adjustable with separate set points for each section of 19,200 eggs.

- **Turning programmes.**

As our knowledge of embryology continues to grow, we are prompted to investigate different incubation programmes and modes. Studies have also revealed the benefits of different turning principles during incubation and SmartDrive now offers the ultimate in flexibility, for adjusting turning programmes as and when required (frequency of turning, two or three auto turning positions, start/stop timing).

SmartCenter information system.

Central database

From batches of hatching eggs and day old chicks, to incubators, hatchery automation and climate control systems, SmartCenter's powerful, central database streamlines and improves control in the hatchery.

It registers the movement of hatching eggs, alerts you automatically to alarm events, provides a preventative hatchery maintenance management programme and allows the full customisation of different incubation programmes.

Three main programme tiers provide rapid access to SmartCenter's complete information system:

- **Hatchery operations.**

Continuously monitor incubators, hatchery automation and climate control systems. Fine tune settings for optimum incubation conditions at all times.

- **Hatchery management.**

Manage key functions from track and trace, alarm management and maintenance to breed specific incubation programming.

- **Hatchery analysis.**

Query production activities and associated information. Produce real time management reports for analysis and decision making.

Conclusion

From conception, the new Smart incubation system has been designed to overcome all three key challenges in hatchery operations:

- Enables the hatchery to fully realise the benefits of genetic advancement, with the capacity to cater for the incubation requirements of specific and individual breeds, now and over the next 20 years.
- Reliably and consistently delivers high chick uniformity, due to its modular design and its unique control systems and programming parameters.
- Dramatically improves post hatch performance in terms of liveability, feed conversion, growth rate, processing yield and egg production. ■

Table 2. Field data post hatch performance (2007). Homogeneous incubation conditions result in the shortest spread of hatch to give high levels of uniformity and the fullest expression of genetic potential. Accurate and sensitive management of embryonic temperature is only achievable in a modular single stage incubation environment, providing homogeneous temperature distribution.

	Multi stage incubation	Pas Reform single stage incubation	Difference
Bodyweight at five weeks (g)	1702	1742	+40
Feed conversion (1700g)	1.71	1.64	-0.07
Mortality (%)	5.75	5.14	-0.61