NELES: From Ten Cutting 90% of

Paris Agreement has set a goal to achieve a carbon neutral world by 2050. However, the United Nations Environment Program's Emissions Gap Report 2020 states that the world is still heading for a temperature rise of more than 3°C this century which is far beyond the Paris Agreement goal. The role of countries and political decision-making has importance in achieving the goal, but the acts of individual companies has equal importance, as the target of reducing emissions requires a huge amount of small action on many different fronts.

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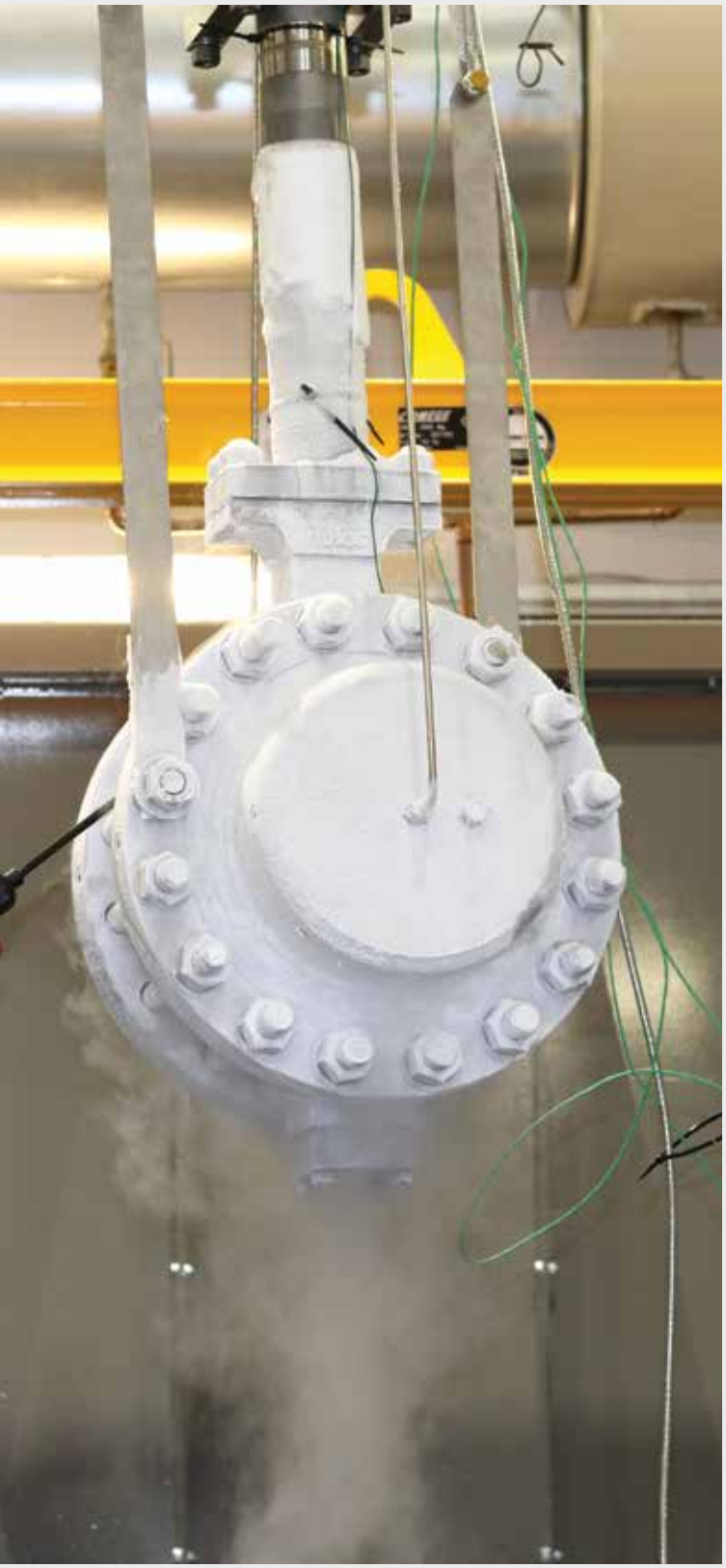
Many oil & gas companies have already published their strategies to reduce the emissions, and from process industry perspective there are two more drivers in addition to regulations dedicated to lowering fugitive emissions: safety and process efficiency. With low levels of fugitive emissions, plants can more easily ensure healthy and safe working conditions for their employees. Also, in many cases adequate emission performance of the equipment means better process efficiency and improved yield, so it also results in financial benefit. The role of a valve manufacturer in this environment is to support global development by introducing even better technologies and inventions to reduce the fugitive emissions. This is great and rewarding task, but it requires deep expertise from several technical fields, from materials science to practical manufacturing.

Tiny emissions require mighty amounts of knowledge

Let us look at what it takes to develop valve emission capability by one tightness class. The second-best tightness class according to ISO 15848-1 is 'B', which is still very much in use, allows a maximum leakage rate of $1{,}78 \cdot 10^{-6}$ mbar·l·s–1 per mm stem diameter. The equivalent number in the best tightness class 'A', is $1{,}78 \cdot 10^{-7}$. That is one-tenth of class 'B'. *In other words, to improve the emission class from tightness class B to A, one must reduce 90% of the valve emissions. Reducing such great amounts of already small emissions requires a careful approach and lots of knowledge.*

How much do those very tiny emission flows amount to? Let us take an example valve, with a 25mm shaft di-

Tennis Balls to One Valve Emissions



ameter. According to the ISO 15848-1, tightness class 'B' would allow a maximum volume emission flow of 1.4 liters per year. This is roughly the volume of ten tennis balls. The tightest 'A' class would allow a maximum emission flow of 0.14 liters per year, resembling roughly the volume of one tennis ball.

Altogether the volume of one tennis ball is not that much, one refinery has thousands of valves installed and if their emission capability is not up to date, the many tiny emission flows contribute to a much bigger total emission flow from the refinery.

How do you reduce 90% of valve emissions?

First, one must know all the essential parameters in valve packing design that contribute to valve emissions. When considering a valve packing, parameters include the effect of packing ring's compression force and the effect of packing bore and shaft surface roughness. After finding the parameters, one should also find the optimal values or optimal range for the values. Finding the optimal values requires lots of careful testing. The use of modern simulation tools can speed up this work considerably. Furthermore, quality techniques, such as Six Sigma will shed light on the complex network of dependent variables behind valve emission capability.

Easy serviceability and professional maintenance personnel play a crucial role in the low emission performance during the valve life cycle.

The design alone does not automatically yield valves with excellent emission capabilities. In addition to design, there needs to be a very tight and seamless collaboration between manufacturers making valve components and skillful workers assembling them right. Building a valve with optimal emission performance begins with components carefully manufactured according to specifications. Any flaws in the components may reflect in emission performance. In addition to the component manufacturing, the assembly process of a valve must be done with utmost accuracy and care, down to the smallest details.

The third link in the chain is the testing laboratory. Simulation tools can help, but good emission capability requires a vast amount of testing. This starts at the material and component level, all the way up to valve assemblies of a valve and actuator. Emission performance is often tested with helium as a test media where the possible helium flows are detected using a helium sniffer. The process of finding the right values for emission parameters includes a fair amount of trial and error. When everything is done right, the final validation and proof of great design and manufacturing effort can realize the excellent emission capability of a valve.

It is a good achievement to meet the tightest 'A' emission class in an on-off valve where the valve will not operate that many cycles during its life cycle. It is a great achievement is to achieve – and remain – in the best possible tightness class for a control valve operating a huge number of open-close cycles in its lifetime.

The very fine balance between tightness and long-lasting tightness

There are two categories of tightness certificates for valves. In the on-off category, the challenge is to achieve the stringent 'A' tightness class. In the control valve category, the first challenge is the same, meeting the 'A' tightness class, but the second can be even more challenging: maintain the 'A' class emission capability over 100,000 operation cycles, in the most demanding test.

In principle, one can design a very tight valve packing by simply adding a huge compression force over the valve packing rings – the tightness is guaranteed. However, when one starts to operate the valve by rotating the

valve shaft, the packing rings start to lose their tightness very rapidly due to wear in the rings. Thus, one needs to find the very fine balance by adding enough compression force to achieve the needed tightness class, but no more to have the packing ring wear under control during the 100,000 cycles.

Vast changes in flow media temperatures cause challenges for valve design and manufacturing. Neles can deliver valves to very low temperatures, the new liquid hydrogen applications go down to -253°C – which is only 20 degrees above the absolute zero point (-273,15°C). In hotter applications, the temperature can be almost 800°C above the liquid hydrogen temperatures. The vast spread in process temperatures set different kinds of requirements for valve material selection and design, as well as testing at various temperatures.

Closing the loop with life cycle care

To demonstrate this challenge and its impact on a global scale, let us use a practical example. Cutting 90% of valve's fugitive emissions can roughly be translated into reducing the leakage from a size of ten tennis balls to a size of one tennis ball only. As discussed above, such an improvement requires careful attention during the entire design and manufacturing phase of the valve, but when this is ramped up to the global scale, the environmental impact is huge. There are millions of valves operating in plants around the world that have been specified tens of years ago that do not anymore meet today's more stringent requirements. Therefore, upgrading their fugitive emission capabilities can turn into a significant act from environmental perspective.

However, even the best construction does not last forever, as all materials tend to wear when exposed to load and friction. Therefore, easy serviceability and professional maintenance personnel play a crucial role in the low emission performance during the valve life cycle. As we have learned, the surface roughness of the packing bore, for example, has a significant effect in cutting the emissions, so even one minor error in service can destroy the tightness of the valve packing. Neles recommends always using qualified service personnel to hold the responsibility of the entire overhaul, starting from planning which part of the equipment should be serviced and which are the critical parts that should be changed. This will ensure that a safe working environment, reliable functionality and environmental goals are considered – and brings us all one small step closer to a carbon neutral society.

Neles At a Glance

NELES

Neles has delivered reliable performance, expertise and innovation since the 1950's. Delivering mission-critical flow control innovations, technologies, and services for the continuously evolving needs of global process industries, Neles helps customers to improve their process performance and ensure the safe flow of materials. We drive profitable growth and sustainable productivity across our customer industries.

- *Sales: EUR 576M*
- *Employees: 2,840 members in approximately 40 countries*
- *7 Valve Technology Centers*

Critical product portfolio:

- *Control valves*
- *On-off valves*
- *Intelligent safety valves*
- *Valve controllers, actuators, limit switches*
- *Valve spare parts*
- *Services*

Leading brands:

- *Neles™, Jamesbury™, Easyflow by Neles™.*

Process Industries Served:

- *Pulp, paper and bioproducts*
- *Oil & Gas*
- *Chemicals*
- *Mining and metals*
- *Others including Power, water treatment, food & beverage, etc.*

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