

Phase out of R141b: major step in SA's HPMP

By John Ackermann

Where are we with banning the importation of the HCFC blowing agent R141b in terms of South Africa's phase-down schedule for ozone depleting substances?

As a signatory of the Montreal Protocol, South Africa phased out the importation and production of CFCs on 1 January 1996. Because of the high ozone depletion potential (ODP) of CFCs like R11, R12, and R502, the international community first focused on the phasing out of these man-made substances to halt the damage to the ozone layer at between 10 and 30km above the earth's surface.

The next step is to phase out the remaining ozone depleting substances (ODSs), predominantly HCFCs, which have a much lower ODP. These include substances like R22, R123, R124, R141b, R142, and methyl bromide.

South Africa commenced with the phasing out of HCFCs by setting a baseline of importations as the first step in a long-term plan towards zero importation and usage of man-made ODSs by 2040. Zero usage would require a change in technology, alternative equipment, training of different hands-on skills, and different manufacturing processes to those that had made use of HCFCs for decades. The HCFC Phase-out Management Plan (HPMP) was formally published in *Government Gazette* No. 37621 of 8 May 2014. The baseline was set in ODP tonnes, a product of tonnage and ODP of all the man-made HCFCs in use, for example 3 720 tonnes of R22 with an ODP of 0.055 equated to 204.6 ODP tonnes. Based on South Africa's average importation of HCFCs in 2009 and 2010, the baseline included R22, R123, R124, R141b, and R142b in pure form or as a component of a chemical composition or blend.

SWING TOWARDS LOWER GWP ALTERNATIVES

Unlike R22, with its many applications and hundreds of users across a very wide cross section of the industry, each with its unique requirements, techniques, equipment, and skills, R141b had limited users and mainly in foam blowing and the manufacture of rigid polyurethane. To a large extent, alternative methods and blowing agents were available and some tested in other countries.

As a crucial step in the HPMP, the importation of R141b was banned from 1 January 2016. With an ODP of 0.11, the ban on R141b importations would

eliminate approximately 43% of the baseline. This ban would facilitate that the annual targets towards zero HCFC imports would easily be met or possibly accelerated without any detrimental impact on the economy or contributing towards job losses.

The United Nations Industrial Development Organisation (UNIDO) is assisting the country to phase out the use of HCFC-141b in the foam-blowing industry, reduce the overall HCFC consumption by 35% in 2020, and secure additional voluntary reductions. The first step of the HPMP aims to encourage not only the phase out of ODSs, but also to emphasise the swing towards low global warming potential (GWP) alternatives and high energy-efficiency solutions that will result in a CO₂-equivalent emission reduction of about 969 535 tonnes in the PU foam sector and savings of approximately 1.8 CO₂-equivalent tonnes to each kilogramme of HCFC-22 not emitted due to better refrigeration practices.



Photos by John Ackermann

Yuri Sorokin of UNIDO during a visit to South Africa.



Bruce Elliot of Resikem with Alan Yeates (left).

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With his many years of experience in the foaming sector, Alan Yeates was contracted by UNIDO to assist in the phase out of R141b. He relates the steps towards zero R141b usage.

UNIDO TECHNICAL ASSISTANCE

The phase out of HCFC-141b, used as the primary blowing agent in rigid insulation foam and microcellular integral skin foam, was prioritised by the project to maximise ODP reduction. In 2010, the baseline consumption volume for these applications was determined to be 1 656 metric tonnes (mt) with an ODP value of 182.2 metric tonnes.

The foam sector is complex; therefore, to meet the country's targeted commitment to the phase-out programme of all ODS-containing substances, the majority of the required phase out was achieved either through systems house conversion and downstream modifications, or in the case of larger consumers, the conversion to alternative foaming agents. The revised target date of 1 January 2016, the firm indication of the government's commitment to ban imports of HCFC-141b, both pure and contained in pre-blended polyols, has also been established.

To put it across, the plan of action was agreed between the Department of Environmental Affairs (DEA) that acts as the National Ozone Unit in South Africa, and UNIDO, the implementing agency, and consisted of four stages, namely:

- **Stage I:** Identification of alternative technologies to replace HCFC-141b; their availability on the market; and capability of the local industry to develop substitute polyurethane foam systems to replace currently used HCFC-141b foam systems.
- **Stage II:** A needs assessment of the self-blenders and systems blending houses to be determined. Financial assistance to be provided for the equipment, enabling the development of foam systems by using alternative blowing agent technologies where needed.
- **Stage III:** Process evaluation by means of small-scale trials to be carried out by the end users of the alternative blowing agent foam technologies. Financial assistance to be provided for the modification of the process or plant where needed.
- **Stage IV:** Commercialisation and implementation of chosen foam technology by the end of 2015.

As a result, a market survey to determine industry requirements was completed, and four replacement technologies, though not all suitable for all applications, were identified under Stage I of the action plan. For instance, cyclopentane, highly flammable and rather costly in terms of conversion, is



At CIP: Nic Carpenter and Alan Yeates (right).

suitable for large-scale use, whereas methyl formate, also highly flammable in pure state but safe in blend, bears low cost for conversion and is suitable for medium to small enterprises. HFA 245/365, applicable for medium-sized enterprises, is safe in blend albeit costly and has zero ODP; yet, it has GWP. Lastly, formic acid, added as third component, is suitable for large-scale use but has short shelf life. Water-blown systems still remain available for specialised use.

LIMITED OPTIONS FOR PRE-BLENDED

In conclusion, all technologies are available from the chemical suppliers in South Africa, but for most of pre-blended system users, the only alternatives are methyl formate or HFA 245/365 blends.

The objectives of Stage II of the action plan were also attained. Hence, a needs assessment of the self-blenders and systems houses was carried out and the financial assistance covering appliances,

packaging, as well as construction and insulation subsectors of the foam manufacturing sector, was provided.

By large, the systems house Resikem Benoni underwent the conversion to facilitate the production of methyl formate pre-blended polyols systems and, therefore, received funding for procuring storage tanks, pumps, and ancillaries needed. Based on the data of 2010, the overall phase out of 120mt of HCFC-141b has been achieved by Resikem.



Foaming equipment at Insulated Structures.

Defy appliances in East London and Aerothane Applications in Cape Town were both successfully converted to cyclopentane technology. Thus, UNIDO's financial assistance to Defy covered the procurement of eligible components of the conversion, such as the foaming machines, storage tanks, as well as preparation of specifications, tender documents, and the cyclopentane transition engineering project, among others. In the case of Aerothane, the complete conversion included a number of additions and modifications to the existing factory and equipment, namely installation of the fire doors and the roller shutter door, fire walling and ventilation, relocation of gas sensor and switch gear, and so on. Furthermore, the conversion of Defy and Aerothane has resulted in phase out of 353.0mt or 38.9 ODP tonnes of HCFC-141b, starting the HCFC-free production for both enterprises.

CIP Industries Strydom Park, a moulded packaging manufacturer of insulated boxes for the pharmaceutical industry, is another beneficiary of this HPMP. Aiming to phase out the use of HCFC-141b in its production and, therefore, replace it with cyclopentane, the enterprise received funding to support the conversion and

procured a machine that will blend polyol with cyclopentane according to the stipulated polyol formulation.

Lastly, funding for storage tanks and ancillaries were allocated for Rigifoam Benoni, a self-blender and manufacturer of rigid polyurethane block foam, flexible faced laminated board, and polyurethane systems. As a result, the enterprise succeeded in the implementation of the conversion of HCFC-141b to methyl formate and other flammable blowing agents.

Based on the small-scale trials, Stage III of the action plan has outlined some valid issues. Problems related to the corrosion of components of the high-pressure foaming machines, emerging from the use of methyl formate-blown foam systems, have been encountered by numerous end users. A corrective action to replace the affected components, such as polyol pumps, injector nozzles, and flow meters, has been taken. Hence, machine modifications and the conversion to methyl formate have been completed at Vela Building Solutions, Zero Appliances, Dalucon Building Panels, Kwikspace, Staycold, National Luna, and Box On Line.

Finally, as seen from the aforesaid, the objectives of Stage IV of the action plan were achieved in a timely manner, that is:

- Commercialisation and introduction of alternative foam technologies, with some use of residual chemical stock, completed by November 2015; and
- Import ban imposed on HCFC-141b, both pure and contained in pre-blended polyols, effective from 1 January 2016.

Nevertheless, in continuation of success and to evaluate and follow up on changes to the technology, plant, and equipment introduced during the initial phase-out programme, the extended work plan for 2016 was further developed and implemented.

IMPLEMENTATION PROGRAMME EXTENDED

To conclude, it is worth mentioning some observations derived from the implementation of this project. Thus, on the one hand, the change of the blowing agents, in most cases, was achieved without much trouble; bearing testimony to the capability of the systems houses to reformulate systems technology to meet market requirements.

On the other hand, particular difficulty was experienced by the end

users where large volume chemical dispensing was required and which could not be corrected by the chemical reformulation. In these instances, the solution was to provide the foaming equipment that is capable of delivering the required mass. The extended work programme was introduced to deal with such matters. As a result, the high-pressure foam dispensing machines were provided to replace the existing low-output, low-pressure machinery. Beneficiaries of this programme were Colcab Cape Town, Insulated Structures in Kya Sands, and Concord Refrigeration in Natal.

In general, the phase out of HCFC-141b has been achieved within the targeted time frame and with little disruption to the industry; hence, ensuring both short-term phase out, as well as long-term sustainability of the industry.

The implementation of the phase-out plan created opportunities to improve productivity and quality. "Moreover, on top of the overall cost-effectiveness of the conversion of the entire foam sector in South Africa, the work programme has resulted in no job losses, with new work opportunities now being created," said Yeates. 



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