CES Working Paper 01/99

Environmental Comparison of Glass Furnace Emission Scenarios

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ISSN: 1464-8083

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Published by:
Centre for Environmental Strategy, University of Surrey, Guildford (Surrey) GU2 7XH, United Kingdom
http://www.surrey.ac.uk/CES

Publication date: 1999

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Abstract:

This document sets out an independent expert assessment of the proposed emission levels from Pilkington's UK6 float-glass furnace. The pollutants considered are particulates (PM_{10}), nitrogen oxides and sulphur oxides. Pilkington suggest measures which reduce all three emissions, whereas under Local Authority Air Pollution Control (LAAPC) greater reductions in particulate emissions are proposed but with no reduction in nitrogen or sulphur oxides below current emission levels. The alternatives are compared in terms of their impacts on human health (based mainly on the recommendation of COMEAP) and the non-human environment (assessed by the "problem oriented" approach used in LCA in terms of acidification, photochemical ozone creation and eutrophication). It is concluded that the emission limits suggested by Pilkington would lead to lower impacts in all these categories.

The arguments in this report recognise that there are inherent uncertainties in this kind of assessment, but that decision-makers need to make the "best" decision possible given the uncertainties. Where simplifying assumptions are needed, these have been made to favour the emissions proposed under LAAPC. Even so, the levels suggested by Pilkington emerge as clearly preferable. Hence, the recommendation is clear in spite of the uncertainty: the emission limits suggested by Pilkington should be adopted as the basis for discussion between glassmakers and the regulators, rather than those proposed under LAAPC.

Keywords

Glass furnace emissions, LAAPC, human health impacts, environmental impacts, particulates, nitrogen oxides, sulphur oxides, BPEO, IPPC directive, decision-making, uncertainty

Table of Content:

Main report:

Summary

1. Purpose and frame of reference 1

2. Introduction 2

3. The process of regulation and the contributions of this document 4

Current emissions and proposed changes 6
4.1. Current emissions from the UK6 furnace 6
4.2. Proposed changes to the emissions 11

5. Estimation of the fates and human health and environmental effects of atmospheric emissions 13

5.1. Uncertainty and the estimation of fates and effects 13
5.2. Estimation of human health effects from dosimetric, toxicological and epidemiological evidence 18
5.3 Estimation of environmental effects 24

6. Human health effects 27

6.1. Particulates 28
6.2. Sulphur dioxide and other related compounds 38
6.3. Nitrogen oxides and other related compounds 42
6.4. Combined effects 49

7. Environmental effects 50

7.1. Particulates 51
7.2. Sulphur dioxide and other related compounds 51
7.3. Nitrogen oxides and other related compounds 52
7.4. Combined effects 53

8. Assessment of the two abatement options 53

8.1. Quantitative assessment 53
8.1.1. Potential human health effects 53
8.1.2. Potential environmental effects 59
8.2. Qualitative assessment 64
8.2.1. Potential human health effects 64
8.2.2. Potential environmental effects 65
8.3. Additional consideration 66

9. Conclusions and recommendations 68

10. References 69

Appendix: Supporting and Background Information

A.1. Introduction 76

A.2. Managing uncertainty, question framing and the Secretary of State's Guidance Note 76

A.2.1. The nature of the uncertainty and its influence upon decision making 76

A.2.2. Effective management of the uncertainty 80

A.3. *General characteristics of the significant emissions* 82

A.3.1. Particulates 82

A.3.2. SO_2 and related compounds 87

A.3.3. NO_x and related componds 89

SUMMARY

This Report provides an independant expert opinion on the relative human health and environmental benefits of the emission limits for the UK6 gas-fired float glass furnace operated by Pilkington plc., proposed under Local Authority Air Pollution Control (LAAPC) for implementation by 1 October 2001, compared with levels suggested voluntarily by Pilkington plc. To ensure that any assumptions which have been made do not artificially favour the levels suggested by Pilkington plc., in accordance with 'best scientific practice', those which least favour the Pilkington levels have been adopted throughout.

The comparison has focused on the proposed changes to those emissions deemed significant and hence to require regulation, namely:

- particulates,
- sulphur dioxide (SO_2) and
- nitrogen oxides (NO_x).

Hydrogen fluoride (HF) and hydrogen chloride (HCl) emissions are also regulated under LAAPC. However, current emission levels are well below the regulatory values. Hence, they are considered no further.

For the other emissions, comparisons of the relative potential human health and environmental effects have been based upon the evidence provided by five separate but related investigations of the relative merits of the two options against a number of criteria. These are quantitative and qualitative assessments of potential human health effects and environmental effects, plus a further consideration explained below.

The quantitative assessment of the relative potential human health effects used the exposure-response coefficients developed by the Sub-Group of the Committee on the Medical Effects of Air Pollutants (COMEAP, 1998) to compare the relative incremental differences in the number of potential deaths and respiratory hospital admissions which may be attributable to each option.

The quantitative assessment of the relative potential environmental effects used the ICI Environmental Burden methodology, which classifies and characterises the contributions of the emissions to a number of commonly accepted environmental effect types.

Uncertainties underlie both methodologies. However, with both quantitative approaches, the support for the levels suggested by Pilkington plc. over those proposed under LAAPC is so strong and unequivocal, that the authors are of the opinion that quantitative (and detectable) human

health and environmental benefits would indeed be accrued should the levels suggested by Pilkington plc. be adopted rather than those proposed under currently under LAAPC.

To support the quantitative assessments, reviews of currently available literature regarding the likelihood of human health and environmental effects from the emissions in question, at expected ambient atmospheric concentrations, have been conducted and are also included. The following considerations confirm the conclusion:

1. The levels suggested by Pilkington plc. would contribute to the reduction of the potential health effects associated with SO_2, NO_x, particulates, O_3 and other secondary pollutants associated with these compounds. The LAAPC proposal, on the other hand, would only reduce the potential health effects associated with particulates and other secondary pollutants associated with them.
2. Even though the reduction in the particulates in the Pilkington plc. proposal would be slightly less than in the LAAPC proposal, the authors consider this to be more than compensated for by the reductions in the other pollutants.
3. A significant proportion of ambient respirable particulates (and this probably includes ultrafine particulates) are secondarily formed. Thus, they are not emitted as particulates but instead as gases such as NO_x and SO_2. Therefore, the most effective means of reducing the ambient respirable particulates (i.e. PM_{10}s) which owe their origin to the UK6 furnace, should be to reduce the SO_2 and NO_x in addition to the primary particulates, instead of focusing on the primary particulates (which is the approach being adopted in the LAAPC limits).
4. Ultrafine particulates (i.e. diameter <0.05μm) may be responsible for the fact that the exposure-response relationship between particulates and health effects appears to be non-specific with respect to their chemical nature. Since the secondary particulates, when they form, will initially be fine particulates and many will probably fall within the ultrafine range, reducing the precursors at source (i.e. by .reducing SO_2 and NO_x emissions) will specifically target one of the sources of these ultrafine particulates. Thus, any approach which reduces such precursors will be favoured by the authors.
5. There is considerable uncertainty underlying the health effect assessments for all of the pollutants considered in this section. Since all have been shown to have the potential to give rise to significant health effects, the authors consider that it would be preferable to adopt the abatement option which reduces the greatest number of these pollutants. Hence, this also favours the levels suggested by Pilkington plc.

The same conclusion -that the levels suggested by Pilkington plc. represent the better option -follows from assessing environmental impacts:

1. The levels suggested by Pilkington plc. have the advantage over those proposed under LAAPC in that they would decrease the contributions of the emissions from the UK6 furnace in the following impact categories:
   - acidification (from SO_2 and NO_x),
   - eutrophication (from NO_x),
   - photochemical oxidant formation (from NO_x) and
   - global warming (from O_3 which is a product of NO_x).
2. The main environmental problems associated with ambient airborne particulates are visibility reduction and the soiling of materials and structures. Both options would help to reduce such problems. However, the limits proposed under LAAPC would not, necessarily, lead to the greatest reductions since a significant proportion of the particulates are likely to be secondarily formed. Whilst the LAAPC limits would not reduce the secondary particulates, the levels suggested by Pilkington plc. would do so.
3. Additional reductions in the environmental effects attributable to SO_2 and NO_x (and their related compounds) will be accrued, since emissions of these substances would be reduced under the levels suggested by Pilkington plc. but would be unaffected under the limits proposed under LAAPC.

The additional factor which has been considered, is that meeting the limits required under LAAPC would mean that Pilkington plc. would probably have to install a dust arrestment plant. However, the improvements suggested by Pilkington plc. would be achieved by reduction at source. Since any apparently non-specific health effects attributable to airborne particulates may be associated with the ultrafine size range, approaches which are more efficient at abating such particulates would be preferred. From available evidence, it appears that the abatement means proposed by Pilkington plc. to achieve the levels they are suggesting would be the most efficient at abating such particles. Hence, this also lends preference to the levels suggested by Pilkington plc.

Thus, against all four criteria (plus the addition consideration) a strong preference for the abatement option suggested by Pilkington plc. has been demonstrated. The authors conclude, therefore, that on the basis of this evidence, the emission levels suggested by Pilkington plc. represent a much greater improvement than those proposed under LAAPC. The forthcoming IPPC directive will ensure that discussions on the most applicable limits will take place. In the long term emissions of all pollutants from the glass industry will be reduced; this work can be used to prioritise which pollutants should be addressed in the short term.