

A EUP directive approach in the design of energy-saving components for cooking appliances

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ENERGY SAVINGS IN PRODUCTION OF GAS VALVES AND IN USE OF GAS BURNERS

New SABAF SERIES III gas burners for domestic cooking appliances have 67% average efficiency, a 20% improvement on the previous generation. This would permit to save millions of tons of carbon emissions and it widens the gap in terms of carbon intensity of delivered energy of gas cooking when compared with electric cooking. Taking into account European installed gas cooking appliances, switching to new SERIES III burners would allow 260 million m³ of gas savings.

The new design of these burners allow also consistent saving of energy spent in production thanks to reduced thickness of enameled steel lids (from 4 to 1,5mm)

New SABAF LIGHT ALUMINIUM ALLOY gas taps allow 28% reduction of the energy spent in production thanks to increased machine productivity, if ROHS would allow the use of an alloy with 1,5% lead, that offers a 1/18 reduction of lead in the valve. Unfortunately, ROHS requires to use 0,4% alu alloys, (=1/31 lead content of brass), that require by contrast 25% added energy for production, reducing to nearly zero energy and cost benefits.

It should be preferred to save 28% energy in production, with 0,102 grams of lead per valve more (4 tons per year with 40m valves manufactured)?

This should be the aim of EUP directive, a more complete environmental impact analysis than the ROHS directive. Introducing a label on surface cooking, with common parameters for electric and gas cooking, is also very much required.

SABAF and the environment

Environment and resources protection are for SABAF a strategic commitment.

For this reason SABAF decided to implement and maintain a System of Environmental Management, compliant with ISO 14001 standard, that, integrated with Quality, Health and Safety Management Systems, contributes as an effective instrument for achieving a constant reduction of the environmental impact of the processes and products manufactured.

Commitments:

- Management of production processes to minimize direct and indirect environmental impacts
- Development and diffusion of eco-compatible technologies and products
- Training employees with the aim to increase their awareness about environmental impacts of their daily activities, while encouraging to act always with respect to environment, and contribute to the achievement of company's goals.
- Commitment to supply local authorities with all necessary information to understand environmental risks related with the company's activity

Corporate Social Responsibility and EUP Directive

Well before the publication of the EUP directive framework y in the Official Journal of the EU Parliament on July 22, 2005, SABAF adopted as a strategy to focus the research and development, both on processes and products, on the eco-design issues, minimizing energy used in production and energy used by products during their working lifes.

This strategic commitment was adopted taking into consideration that energy and environment will be the key factors in the next future, with energy costs that we believe will never come back to less than 10\$/oil barrel as in the early nineties. Obviously, the "energy" argument must be taken in its widest meaning, including also raw materials that are very much dependent from energy costs such as copper, zinc, aluminum and steel. Therefore, minimizing the raw material used in production, and the recycling of the scrap resulting from machining processes, is also a key strategic factor.

Sustainable growth, not charity. Business continuity, not marketing.

The deep meaning of the strategic decisions taken at SABAF in the past few years have to be found in the desire of the shareholders of the company to ensure safe business continuity to the company, through adding value to the product with research and development in the directions set above, and to the company by adopting the most severe corporate governance¹. As an example, the board of advisors includes a majority of independent members, coming from Universities, Institutions and Manufacturers' Associations², and it has been the first in the Italian Stock Exchange.

Two examples of EUP-approach in the design of products: the new SERIES III BURNERS and the new LIGHT ALUMINUM ALLOY GAS TAPS

The development of these new products lines started in 2002, soon after the company moved from the old Lumezzane headquarters to the new Ospitaletto plant, based on 100,000sq.m. available area (60,000 covered).

NEW GAS VALVES MADE WITH ALUMINUM LIGHT ALLOY (EXTRUDED BAR)

After producing for more than half a century taps and thermostats made in brass, and after developing in-house the most automated possible machines for production (20 pcs/minute productivity in machining brass bodies of valves, 60 pcs/minute machining speed of brass plugs) SABAF decided to develop a new range of valves, from scratch. All possible materials were analyzed in order to find the best equilibrium between functional minimum parameters (resistance to 130 degrees, isotropic material, machining speed, energy needed, maximum leakage admitted 10cc/hour even after 40.000 cycles with maximum maneuvering torque = 0,4Nm, etc) and the extruded aluminum alloy coded "2030"³ was found as optimal. Machining speed allowed to machine 40 bodies/minute with a 28% energy saving compared with brass valves. As aluminum has a specific weight 1/3 of brass (2,8kg/dm³ against 8,5kg/dm³), it was easy to evaluate also the importance of this significant weight reduction also in shipments and materials in-house logistics.

Unfortunately, lead content of this alloy is 0,8% – 1,5% and RohS directive prescribes maximum 0,4% lead content in parts for electric appliances, and after some doubts it has been clarified that also gas cooking products, even without any electrical apparatus in the appliance, are to be considered in the scope of the directive.

Therefore SABAF had to switch to a new alloy, called "2015", with more or less the same composition apart from lead content <0,2% (half of the RohS limit set at <0,4%). Unfortunately, this alloy, when tested with high-speed machining tools (needed to achieve the productivity at 40 pcs/min – 20pcs/min with double cycle - in the machining of the body that was one of the project targets), proved to have a completely different behavior than the alloy 2030.

In fact, with the alloy 2015 the scrap resulting from machining was much bigger than the scrap resulting from machining the alloy 2030, with the consequence of a quick filling of the transfer machine with aluminum long scrap parts not broken in small pieces as it happens with the 2030 alloy. This creates the need of an added scrap-braking machine that uses nearly all the energy saved thanks to the increase productivity with 40 pcs/min against 20 pcs/min with brass. In other words, the alloy 2015 RohS-compliant destroys nearly all the cost benefits of using aluminum instead of brass, albeit saving 0,1 grams of lead per valve with respect to a valve made with alloy 2030.

At this point, it is important to evaluate in absolute terms the content of lead per valve in the three cases: brass, alu alloy 2030, alu alloy 2015:

¹ For more news on SABAF corporate governance statements and regulations, see http://www.sabaf.it/english/Company/Stock_Exchange/Corporate/corporate.html

² For the list of directors see http://www.sabaf.it/english/Company/Stock_Exchange/Corporate/The_Board_of_Directors/the_board_of_directors.html

³ Characteristics: <http://www.eural.com/2030ita.htm>

ALLOY	ROHS	MAX LEAD CONTENT %	SPECIFIC GRAVITY	LEAD CONTENT PER VALVE IN GR	MAX PRODUCTIVITY (machining of body of valve)	ENERGY SPENT IN PRODUCTION
BRASS OT58 UNI 5705	COMPLIANT	4%	8,5kg/dm ³	1,4	20 pcs/min	100%
ALUMINIUM ALLOY 2030	NOT COMPLIANT	1,5%	2,8kg/dm ³	0,15	40 pcs/min	72%
ALUMINIUM ALLOY 2015	COMPLIANT	0,2%	2,8kg/dm ³	0,034	20 pcs/min	90%

Now, taking into account an estimated production of 40 million valves per year in Europe, the total lead content would be as follows:

ALLOY	LEAD CONTENT PER VALVE IN GR	ANNUAL PRODUCTION EU	TOTAL LEAD	IN REF TO BRASS
BRASS OT58 UNI 5705	1,4	40M	56TON	100%
ALUMINIUM ALLOY 2030	0,15	40M	6TON	10,7%
ALUMINIUM ALLOY 2015	0,034	40M	1,36TON	2,43%

It seems evident that saving 4,64 TONS per year of lead, if not properly recycled, means significant losses in terms of energy spending.

SABAF reacted with a request of exemption from the requirements of article 4 (1) of directive 2002/95/EC⁴. To this request, a major player of appliance industry replied that there are already valves made with 2015 alloy, ROHS-compliant proving that is technically feasible. But SABAF did not want to contest the technical feasibility of valves with the 2015 alloy, but the fact that with 2030 alloy and 1,5% lead content, the final result in terms of lead content is only slightly higher, but with significant savings in terms of energy expenditures in production, and therefore the total balance of hazardous materials, taking into account the ones coming from energy production, is in favour of the alloy 2030. This, obviously, taking into account state-of-the-art machining techniques and machinery and the highest possible productivity in both cases.

In a tentative EUP ECO-REPORT included in his presentation at a recent conference in Milan⁵, Mr Kemna of Van Holstein Kemna pointed out the environmental pollution deriving from energy production in Europe⁶. For every kWh used, as an average 31 liter of water are used for cooling turbines in electricity production, 0,27 grams of hazardous waste and 13,6 grams of non-hazardous waste are produced, 0,5kgCO₂ equivalent is the Global Warming Potential index, etceteras.

It is clear from this analysis that the approach of the EUP directive is much more complete and effective than the ROHS approach, as it seems that at least in the case of gas valves for domestic appliances the total balance obtainable with the aluminum alloy 2030 is preferable for the environment than the result obtained by using the alloy 2015, thanks to the much lower energy consumption.

But the biggest problem posed by the RohS limits will be the price of the valves. With the aluminum alloy 2030, thanks to lower energy consumption and bigger productivity, it was possible to reduce

⁴ <http://forum.europa.eu.int/irc/Download/kwecA8JEmWGIXkJ3D3oIMeMf6x9OZGnBoy9Lolc4KBSGUptq1YUaO-0H8WVHgZtIYhSDPBFYFHj1dPI/SABAF.pdf>

⁵ "ENERGY AND CARBON SAVING IN COOKING", Milan March 30th 2006

⁶ "Eco-design for Energy-using Products: Methodology and Possible Implications for the Cooking Sector" - René Kemna – Van Holstein Kemna - " <http://www.sabaf.it/download/RKemmar.pdf> "

production costs by 15%, while with the alloy 2015 the reduction is much less significant. Therefore the risk of little success of these valves on the market and (as a consequence) the presence for many years more of brass valves (still permitted by ROHS with 4% of lead and with a gravity three times aluminum) with much more lead and much more energy consumption.

It would make much more sense to use in the ROHS directive a maximum admitted level of hazardous materials using VOLUME rather than WEIGHT. It is evident that a certain product that can be produced both in brass and aluminum, will have more or less the same volume but very different weights, and that it would be preferable, in any case, to have a valve made with aluminum and 4% lead than the same valve in brass with 4% lead: as specific weight of aluminum is roughly 1/3 of brass, this 4% would turn automatically to 1,3%.

BURNERS SERIES III

After 7 years of successful sales of the burners SERIES II (from zero to 20 million pieces manufactured in 2003), SABAF started the development of a new generation of burners, with two main project targets: to have a range with the maximum efficiency possible and to minimize the differences needed to adapt burners from EU standard to AGA/CSA standards (US standards). Considering the fact that within US standards, efficiency is not calculated, it was quite an ambitious target. Obviously, also a cost target was set: maximum 10% more than SERIES II burners, calculated with similar quantities in production. Again, it was implicit that the new burner should have to work with primary air intake from above, radial Venturi and similar flexibility in terms of aesthetical variants as the SERIES II.

The result of a substantial increase in efficiency was obtained thanks to a very different design of the burner, that present inclined flames and a domed lid much thinner than the SERIES II lids (1,5mm instead of 4mm). Rigidity of the lid was ensured by the domed shape, while the flat shape of lids SERIES II made necessary to use 4mm thickness, as temperature reached by the lid during combustion is 650 C° plus, and at this temperature a thinner lid tend to bend, if flat, and the combustion parameters (production of CO) go out of international standards' limits⁷.

Moreover, enameling a lid made with 1,5mm steel is much easier and less energy-intensive, as on the market it is possible to find steel sheet de-carbonated and ready for enameling, while the 4mm sheet is partially de-carbonated and the residual carbon included in the alloy tends to react with the iron oxides of enamel (needed to attach the enamel to the steel of the lid) and create aesthetical defects. An efficiency of 65% has been achieved, against a minimum 52% required by EU standards and an average 56% of SERIES II burners. In other terms, 25% more than minimum required by standard and 16% more than SERIES II burners.

The effects in terms of carbon emissions

We can compare the difference in carbon emissions between Series II and Series III SABAF burners. Taking into consideration the different efficiency, and a similar consumption pattern⁸, with SERIES III burners sold in the same number of Series II (21 million burners in 2004), the saving would be around 260 million m³ of gas in one year, the consumption of a city like Milan. If ALL burners equipping ALL appliances sold in EU would be with efficiency like SERIES III, the saving would be more than double (=approx 420 million m³).

With this kind of reduced consumption with 21 million SERIES III sold in the place of 21 million of SERIES II, the net effect would include savings of 2,2 million m³ of CO /year and 260 million m³ CO₂ /year. Again, this calculation is based only on the change SABAF SERIES III / SERIES II. A complete switch of ALL burners sold in EU in one year (the SABAF market share with direct sales is around 45%, but every year many million burners more are made with the same working principle patented by SABAF in 1981 and expired in 2001), would probably double these figures to 4,5million m³ for CO and 550 million m³ for CO₂.

The EU standard applicable

Currently, efficient burners are not receiving any attention by the EU standards. The EN 30.1.1 fix at 52% the MINIMUM level of efficiency required on burners of domestic cooking appliances, but there is

⁷ CO limit within EN30.1.1 standard is 0,1%

⁸ Consumption based on a standard 4 gas burner hob (one Rapid 3kW, two Semirapid 1,75kW, one Auxiliary 1kW), daily use for one hour of for Semirapid and Rapid burners and ½ hour for the Auxiliary burner, supplied with Natural Gas.

no label nor any other kind of information to consumers about the differences between the different appliances on the market.

The situation is similar on electric cooking appliances, with the consequence that induction hobs, advertised with “90% efficiency”, are expanding their sales month after month, even in countries with the majority of electricity coming from the combustion of fossil fuels at an average efficiency of 40% (ENEL Italy data).

In other countries like Brasil, after a dramatic blackout in the south-east region in 2000, a label on domestic cooking appliances has been introduced. By the way, in the occasion of the blackout, it was clear that electric ovens, quite popular amongst the German residents, were partially responsible for the peaks creating the blackouts, and plans to incentivate their conversion in gas ovens were introduced by the local municipality⁹.

The EU standard desirable

Considering the Kyoto Treaty and the effect it displays in terms of penalties to countries emitting GHG like CO₂, it would in my opinion be evident that standards in EU, wherever emissions of a relevant level are an important issue, would have to fix new, reduced emissions targets in order to push the industry to invest in that direction.

This is exactly what has been done in the recent past with labels on different appliances, and very important results have been achieved.

What is not clear, is the priority assigned to the different appliances to be equipped with a label. Considering ONLY electric cooking appliances, i.e. 50% of the EU total “cooking” market that includes another 50% supplied with gas, the annual consumption of electricity averages 568kWh¹⁰. This is much more than the refrigerator (250kWh), much more than the clothes washer (250), much more than the dishwasher (285), much more of the clothes dryer (430), but ALL THESE APPLIANCES HAVE ALREADY BEEN EQUIPPED WITH LABELS, while SURFACE cooking is still missing the label.

The only label introduced in the cooking sector is related with electric ovens, that contribute significantly to the total consumption of energy in cooking, but it is not the most relevant (surface electric cooking uses more). The label on electric ovens was introduced in 2003, leaving gas ovens without label for the absence of uniformity of results in the ring tests run by 7 laboratories on ventilated “forced air” ovens, even if they represent a very little fraction of the total market¹¹.

It is highly questionable, moreover, the idea to introduce a separate label on ovens (something that should not be repeated with a surface cooking label, when introduced). The idea of the SAVE II project was to introduce a common label on gas and electric ovens, in order to inform consumers about the impact in terms of carbon emissions and/or the average cost per year of use (based on average local costs of natural gas and electricity). Some opposed to this idea by saying that it is preferable not to alter the market between electricity and gas cooking appliance, but it is not clear WHY this should not be done. In London, if authorities did not make a strong battle in order to ALTER the market, most of the heating would still be with coke, and the improvements obtained with the conversion of most of the domestic heating to cleaner energies are evident.

As it is clear that in EU the average carbon intensity of delivered electricity is 0,12kgC/kWh, it is out of discussion what is the best energy to use in cooking in order to save to environment carbon emissions. Natural gas with 0,08kgC/kWh average carbon intensity is a better option. In my opinion, some specific situations, with very low carbon intensity of delivered energy, such as all EU countries with a prevalent production of electricity from renewable sources (Norway with its 90% hydro, as an example) should be considered, and probably a EU label would have to take into consideration local and regional specific situations, in order to avoid inefficiencies.

But it is clear that with oil at 73\$/barrel it becomes a priority to act in all directions in order to save energy, and save emissions to the environment. Any standard modification should really be aimed to

⁹ As communicated to SABAF by local manufacturers asking for a rapid conversion of their electric ovens into gas ovens. SABAF refused due to the impossibility to develop safe ovens without introducing a thermoelectric safety device, considered “too expensive” by manufacturers.

¹⁰ Paolo Bertoldi, European Commission Directorate General, Joint Research Centre, Average Annual Consumption of electricity by appliance type – “ENERGY AND CARBON SAVING IN COOKING”, Milan, Palazzo Stelline 30 March 2006 - <http://www.sabaf.it/download/PBertoldi.pdf>

¹¹ Ettore Barbieri, Technical Manager Gas Sector IMQ, TC49, “ENERGY AND CARBON SAVING IN COOKING”, Milan, Palazzo Stelline 30 March 2006, - <http://www.sabaf.it/download/EBarbieri.pdf>

– at least – incentivate IMMEDIATELY the adoption of EXISTING technologies and products, such as the SERIES III burners.

It is necessary also to clarify that in the case of SERIES III burners, the difference in cost to the manufacturer, compared with SERIES II burners, is limited to a 5% on the price of a set, or (in absolute terms) more or less 0,3 euro on a set of 4 burners. This little difference, taking into account the average cost of natural gas, can be paid back in very short time, with the cost of a m³ of natural gas standing at 0,6€ (Italy)¹². As the difference in the yearly consumption for one hob (pattern usage as per above note number 10) is approximately 50m³, the payback time of the change from SERIES II to SERIES III burners would be only three days of normal use...

These are the technology “jumps” that mark the difference and should attract a substantial interest from authorities, as are IMMEDIATELY AVAILABLE, with research and development costs entirely paid by the private sector¹³ with no contributions and/or investments required to the public sector.

GAS OR INDUCTION, THE NEED OF A SINGLE LABEL IN COOKING

Up to now, we have considered the different efficiency between a gas hob equipped with previous generation burners and SERIES III burners by SABAF. I would like to extend the concept now to electric hobs, in their most efficient version, with induction technology.

It has been clarified many times that induction hobs, due to losses in the production and transport chain of electricity, have a very low efficiency in terms of primary energy¹⁴, approximately only 32% against 65% with gas cooking. This means using the double of the primary energy for the same purpose, i.e. to cook in a family for one year (3.248MegaJoule of energy against 1.667 MJ with gas). But this is only one aspect. Using gas for cooking, in countries with electricity produced with fossil fuels, would leave much more precious electric energy for uses where there is no alternative with other fuels, such as air conditioning or dish washers, where the alternative “gas” solutions are existing only virtually. In other words, there would be LESS need of constructing new power plants, that will for sure be needed in case we do not adopt a “fuel-switching”¹⁵ policy from electric cooking to gas in countries with electricity coming from the combustion of fossil fuels. Obviously, it is true also the opposite: in countries with over-abundant production of electric energy from renewable sources, it would be logic to incentivate and promote the use of electricity for cooking rather than complicating lives with the costly construction of gas networks.

“Fuel-switching” policies are the only way to go. Otherwise, consumers could face a situation with ovens labeled “A” efficient but powered with natural gas, LPG, electricity, and (why not?) coke, wood without any possibility to understand what is the most convenient appliance for their pockets and for the environment.

THE COST APPROACH

Some opponents to the concept of single label in cooking and in whatever appliance sector where two forms of energy confront themselves in the market with more or less the same market share, argue that the concept of carbon emissions, or primary energy consumption, are too complicated for the end users.

In this case, a label indicating the annual cost of running the appliances (similar to the “Energy Star” concept in the US) would be welcome too. At least, there would be smaller space for confusing information coming from interested companies that are spreading the idea that cooking with induction in Italy is convenient in terms of annual expenses for the end users.

¹² <http://www.autorita.energia.it/gas/index.htm>

¹³ SABAF DID NOT received any kind of public funding or incentive of any kind for the R&D investments that originated the SERIES III burners.

¹⁴ Renè Kemna, “Eco-design for Energy-using Products: Methodology and Possible Implications for the Cooking Sector”, “ENERGY AND CARBON SAVING IN COOKING”, Palazzo Stelline, Milan, March 30th 2006 - <http://www.sabaf.it/download/RKemmar.pdf>

¹⁵ As suggested some time ago by DEFRA – Market Transformation Programme in UK. The argument is still valid.

In reality, it is easy to calculate that boiling two liters of water every day makes (in Italy) 8,1€ with gas burners, and 36,9€ with an induction hob, considering, obviously, stand-by losses¹⁶ for induction hobs.

This means a cost nearly 5 times higher with induction than with gas, changing the test methods would not change significantly the result.

CONCLUSIONS

It seems urgent to introduce and/or implement as soon as possible:

1. the EUP directive, a much more comprehensive approach to the energy saving and hazardous materials matter than the separated RohS and label directives. If saving few tons per year of lead as per RohS directive pushes energy consumption for the production of burners up by 25%, with the added production of hazardous materials in electricity power plants, more consumption of water etceteras, this should be considered, and the EUP directive adopts this more comprehensive approach.
2. a single label in the appliances that are in the market with similar market shares in different energy options would help the end users to understand the net effect on their annual costs and / or the effect on the environment in terms of carbon emissions. Such an approach goes in the right direction to limit GHG as per Kyoto's treaties. Separate labels do not help in any way to address consumers on consequences of their choices.
3. companies adopting severe policies in terms of energy saving in production, workers' social rights, use of child labor in production etceteras should receive some attention by the end users via labels or certificates issued by authorities or institutes. In many other sectors the possibility to understand the approach of manufacturers towards these issues demonstrated that "bio" products have an opportunity of market shares even at higher costs. Informing consumers about the country of origin of an appliance (the "made in ..." issue recently under consultation by EU authorities¹⁷) is already a good first step, but a more complete label, rating the social sustainability of the product, and issued by authorities, would be warmly welcome. It is important to clear that such a label would simply accelerate a process already undergoing, as some distribution companies such as IKEA are already adopting severe policies in their imports from non-EU countries, trying to ensure that social conditions of workers in suppliers' plants are falling within IKEA standards¹⁸. This approach is already changing the market, as IKEA asks its suppliers to comply with IKEA's standards, and suppliers' sub-suppliers also have to comply. Again, it seems that the market is running faster than standards, while standards should somehow guide the market towards more sustainable production schemes.
4. In the absence of the above mentioned measures, SABAF SERIES III burners with a total investment of millions of euros will have to compete on the market with burners with a 25% lower efficiency and theoretically manufactured without respecting minimum working conditions, child labor laws, without any possibility for the consumer to be informed about these differences.
5. In the absence of these measures, hobs with brass valves (with 6 times the lead content possible with the aluminum alloy 2030), will be marketed in EU at low prices without anything informing consumers about the differences with hobs made with valves using 6 times less lead.
6. In the absence of a common label for electric and gas ovens, and for electric and gas surface cooking, electric cookers and hobs will be advertised as much more efficient than gas appliances and will increase their market share, with the result of higher carbon emissions, higher electricity consumption during peak hours around meal times, and shortages that could push the idea of the construction of more power plants that are, in reality, not needed, if electricity is used more efficiently.

¹⁶ SABAF Laboratories, test carried out with SERIES III 3kW Rapid Burner, Natural Gas, against standard induction hob from the market, cost of natural gas 0,6€/m³, cost of electricity 0,15€/kWh, 4,5kW meter. Fixed meter fees excluded in both cases. Cost of stand-by only at 13,2Wh (average 10 most sold models in US) = 17,34€ - cost without stand-by 19,56€.

¹⁷ <http://europa.eu.int/yourvoice/forms/dispatch?form=401&lang=IT>

¹⁸ <http://www.ikea-group.ikea.com/corporate/responsible/conduct.html>

