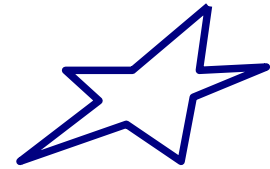


**nova**



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**(Issue 2)**

**25 May 2001**

**REPORT ON RESEARCH INTO  
DOMESTIC STOVE REQUIREMENTS  
AND THE  
DESIRABILITY OF METHANOL AS FUEL  
ON BEHALF OF ORIGO - ELECTROLUX**

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With Sten Danielsson, SD Consulting, and Anders Magnusson, Electrolux

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## ABBREVIATIONS AND DEFINITIONS

LSM	:	Living Standard Measures
MAQ	:	<p>The eMbalenhle Air Quality (MAQ) Project started in 1997, when SASOL Synthetic Fuels (SSF) commissioned NOVA Institute to prepare a strategy to improve air quality in eMbalenhle, with the aim of improving the health of residents.</p> <p>The project is now in Phase III. The <b>goal</b> of this phase is to evaluate, refine and validate possible solutions, until a given solution proves to be <b>effective</b> in reducing air pollution, as well as being <b>sustainable, affordable</b> and <b>desirable</b> to the target community.</p> <p>Phase III is executed by way of an <b>information exchange centre</b> that provides the opportunity for <b>intensive person-to-person communication within a section of the community</b>. The objective is that residents of such a section should accept a given solution, and start to use and propagate it, so that it could spread from there to neighbouring communities.</p>
NOVA	:	<p>NOVA Institute is an independent <b>non-profit organisation</b> with a fund raising number. NOVA's aim is to combat poverty by bridging the <b>gap or conflict</b> between the <b>intentions</b> of those who provide services or products to communities in need, and the <b>perceptions and responses</b> of the communities themselves, in order to improve the effectiveness of such services, especially to the poorest of the poor.</p>
RDP	:	<p>The Government's Reconstruction and Development Programme. RDP Houses are subsidised with R17 000, including the infrastructural costs.</p>
SABS	:	South African Bureau of Standards

## 1. INTRODUCTION

This report presents the result of the investigation as outlined in the proposal submitted by NOVA to SD TRADING-CONSULTING on 2000/11/08, which in turn is based upon the ELECTROLUX pilot project results.

The work is aimed at:

- a. establishing the specifications for a stove that will be specially manufactured for domestic use by low income households in SA, and
- b. determining whether methanol can become a fuel of preference for domestic cooking.

## 2. SCOPE OF WORK

The contents of work under the agreement entailed the following:

- a. Confirm the requirements of SD Trading-Consulting;
- b. Obtain understanding and acceptance for this research from the community leaders;
- c. Plan the research;
- d. Identify / select and obtain support from ten households;
- e. Familiarise research assistants with the operation of the *Origo 3000 stove*;
- f. Train households in the use of the *Origo 3000 stove*;
- g. Visit households regularly (not less than three times per week) to observe the use of the stoves;
- h. Conduct interviews with the households;
- i. Conduct a focus group discussion, and
- j. Interpret the results and present a report to SD Trading-Consulting.

## 3. BACKGROUND

### 3.1 The Origo Stove

Ten *Origo 3000 alcohol stoves* were provided by SD Trading-Consulting. The stove is specifically developed for use in boats. It is a double plate stove without an oven. It was agreed upon with SD Trading-Consulting that, since **methanol** will be used as fuel, all references to “alcohol” on the stove, packaging and documentation will be removed.

### 3.2 The Fuel

Sasol Solvents supplied methanol in 5litre semitransparent containers. *Bittrex* was added as denaturant at a concentration of 0.01g per litre. (30ppm requested by ORIGO-ELECTROLUX). (Fuel characteristics are presented in the Material Safety Date Sheets characterised in appendix B)

The first batch of 30 containers had written safety instructions on one side (see figure 1). The second batch had an additional safety sticker on each container (see figure 2).

METHANOL.  
HIGHLY FLAMMABLE  
CLASS 'A' : FLASHPOINT:9.5°C  
TOXIC - BY INHALATION, INGESTION AND  
ABSORPTION THROUGH THE SKIN

Figure 1: Safety instructions: First and second batch

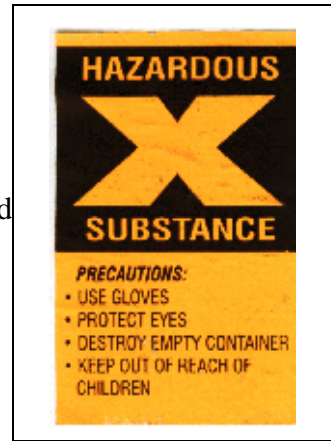


Figure 2: Warning sign: Second batch

### 3.3 Community

eMbalenhle (place of the beautiful flower) is a typical South African township situated 140km south east of Johannesburg. It was established in 1978 as dormitory residential area for (black) workers at the Sasol petrochemical plants and mines. It has approx. 300 000 residents. Sasol is still the major employer in the region. Unemployment is estimated at approximately 50%.

NOVA conducted the assessment in two sections of eMbalenhle, namely Ext. 21, Block A (Samaria Park) and Extension 14, Block C.

Samaria Park is an informal settlement with limited services (a water tap on every third stand, bucket toilets, and refuse removal once per week). It consists of 500 households. Samaria Park is in the process of town proclamation and electrification. All residents stay in informal houses.

Ext. 14, Block C consists of 440 official stands. There are also a large number of tenants and some illegal stands. Ext. 14 is a so-called “sites-and-services” development with a sewerage system, water and an electricity connection per stand. However, some 22% of the households do not use electricity. During 2000, 22% of the structures were formal houses (RDP, self built or prefabricated) with or without informal structures added, and 78% informal structures.

### 3.4 The Sizanani Energy Centre

NOVA established the Sizanani Energy Centre in Samaria Park. The research was conducted from the centre. The centre has a full time coordinator.

A team of ten research assistants, residing in Samaria Park and Ext. 14, worked from the centre and conducted the interviews with households. These researchers have a minimum qualification of Grade 12 and were trained by NOVA in qualitative and quantitative research methods. They have been working with the centre from 1999.

### 3.5 NOVA Researchers

The training of research assistants, selection of households and the evaluation and interpretation of data were done by Pierre Schoonraad and Klaas Moropyane.

Pierre Schoonraad has been conducting research with NOVA for the past five years

and is also a part-time lecturer in Research Methodology at the Highveld Ridge Satellite Campus of the Vaal Triangle Technikon. He is working on a doctoral thesis on the role of the church in informal settlements.

Klaas Moropyane is a resident of eMbalenhle and was trained through NOVA in 1998 in qualitative research methods. He is the Sizanani Centre co-ordinator since 1999. Since his appointment at the centre he has co-ordinated all field work done from the centre and gained extensive experience in qualitative and quantitative research methods.

## 4. METHODOLOGY

The following methodology was followed:

### 4.1 Selection of Households

Specific selection criteria were applied:

- a. Willingness to participate and be interviewed;
- b. Being prepared to use the *Origo 3000 stove* for the full study period;
- c. Energy pattern:
  - All households: current average paraffin consumption of 20 or more litres per month (used for a paraffin stove).
  - Group 1 (four households): Use one or more paraffin stove(s) for cooking.
  - Group 2 (three households): Use one or more paraffin stove(s) **and** a coal stove for cooking.
  - Group 3 (three households): Use one or more paraffin stove(s) for cooking **and** an electric two plate stove for cooking, and
- d. Availability during the study period.

By selecting a sample of households that are typical of the target population, it is assumed that the results are fairly representative.

### 4.2 Training of Research Assistants

Mr Sten Åke-Danielsson demonstrated the stove and emphasised the operating instructions and safety precautions of the stove to the research assistants.

The research assistants were retrained on the basic principles of qualitative research and confidentiality.

The research assistants used the *Origo 3000 stove* for one week before it was taken to the households. This gave them the opportunity to familiarise themselves with the functioning of the stove.

### 4.3 Safety training of respondents

The members responsible for cooking from all participating families were called to the Sizanani centre where the operation of the stove was demonstrated to them.

The safety precautions for the stove **and** fuel were demonstrated to each family. Each family received the modified safety instructions provided by ORIGO-ELECTROLUX and signed that they understand and have received the instructions.

During the first visit to the families the research assistants observed and verified that the families understand and apply the safety instructions.

#### **4.4 Gathering of data**

The perceptions and reactions of the participating households were qualitatively assessed through personal interviews and three group discussions.

##### *4.4.1 Observations and interviews*

Five research teams consisting of two members each visited the houses three times per week to observe stove use. Seven interviews were conducted with each household over the study period. The interviews started with general (non-threatening) questions and gradually focussed on more sensitive issues, such as the price of the stove.

Each research team conducted interviews with two households.

After each round of interviews, the assistant researchers met with the NOVA researchers to discuss the findings and to plan the next interview.

##### *4.4.2 Group Discussions*

Training in the safe usage of the stoves was provided before households used the stoves. A short discussion was held on families' first impressions of the stove. This provided information on reactions that could be anticipated when marketing the product.

After completion of the interviews, two group discussions were conducted with representatives from each household. To facilitate maximum participation, respondents were split into two groups. The group discussions were conducted in isiZulu and led by a NOVA researcher.

##### *4.4.3 Pre-defined questions*

Before the fieldwork started, SD Trading-Consulting formulated eleven questions that needed to be answered through the interviews (see appendix A). However, the NOVA researcher and research assistants conducted "blind interviews", i.e. the research assistants did not know the questions asked by SD Trading Consulting until before the last interview. They conducted non-directive interviews that allow the respondent to determine the issues that are important to him or herself. Questions from SD Trading-Consulting that had not been answered at that stage were then posed in the final interview and during the group discussions. This approach was followed to ensure spontaneous reaction as far as possible uninfluenced by outside concerns from the households and that **their** priorities and perceptions were addressed first.



## 5. RESULTS

The following results were obtained:

### 5.1 General

The *Origo 3000 stove*, with methanol as fuel, enters a community with a specific established energy consumption pattern. To enter the market successfully the product should be desirable, and fit into the household consumption patterns. The figure below presents the position of the *Origo stove* in relation to other products in the market.

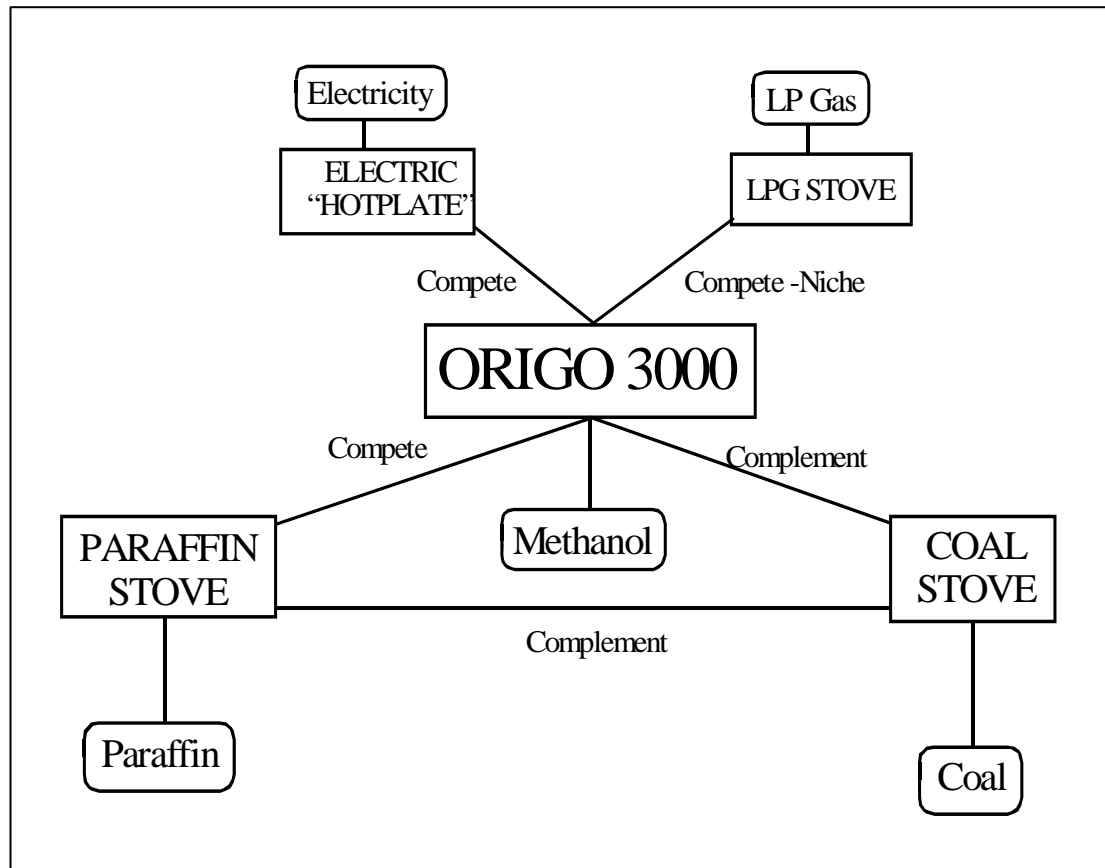


Figure 3: The Origo 3000 in relation to other products

#### 5.1.1 Paraffin (kerosene) and paraffin stoves as competitor

Paraffin is, together with coal, the major cooking fuel consumed in the South African townships. According to the Department of Minerals and Energy, in 1999, more than one million kilolitres illuminating paraffin were consumed in South Africa. Figure 4 presents the consumption per province.

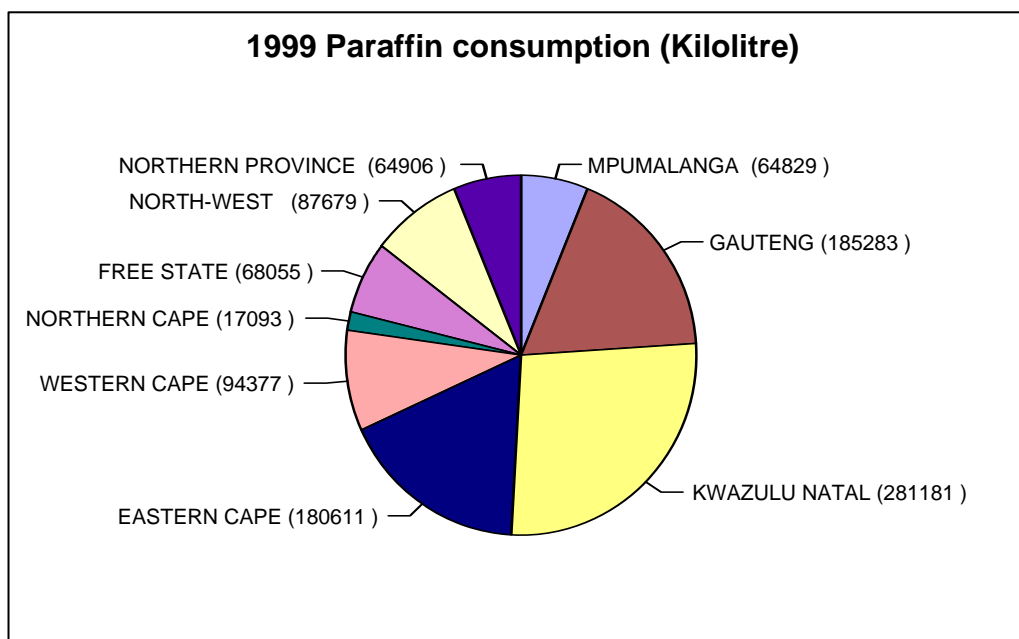


Figure 4: Paraffin consumption per province

Paraffin, however, does have serious negative impacts:

- a) Paraffin stoves are a serious fire hazard;  
Shacks regularly burn down when stoves fall over. Overfilling may lead to explosions. It was found in Duncan Village, East London, that over the past decade, 359 residential fires (mostly paraffin-driven) had destroyed 2 300 houses, that is 1 fire every 10 days, or 1 home destroyed per day. People say: "We live in fire".
- b) It is smelly and dirty;  
You have to open doors or windows for ventilation and this in turn makes the house very cold in the winter. You can taste the paraffin in the food and water prepared on a paraffin stove. The soot makes the pots black on the outside.
- c) It has negative health impacts. People complain of runny noses, headaches and eye irritation caused by paraffin fumes;

Even where communities are electrified, paraffin (and coal where available) are still preferred for various economic, cultural and social reasons. Paraffin and fire have a profound impact on community relations and politics; on household formation and fission; on people's ideas of personhood, power and identity; on the social order based on gender inequality, mass poverty and dependency, and so on.

In spite of all these negative aspects, paraffin remains the fuel of preference of more than 90% of households in Duncan Village. Households with secure incomes constantly back-switch to paraffin, and electricity on its own does not stop residential fires. The main reason for this seems to be that paraffin (like coal), in spite **of** its negative health impacts, and it being dirty **and labour** intensive, symbolises the role of women as homemakers and mothers. It encourages solidarity, sharing and mutual support. It gives the woman power; she could use it to keep men out of "women's business"; it could be manipulated to mystify household budgeting and resource allocation. Men welcome this arrangement because it relieves them of any responsibilities at home, and keeps the women at home.

White et al (1997:413) discusses more reasons why paraffin stays popular:

- d) Electricity is expensive;
  - e) Electricity supply is unreliable because of power failures and disconnections;
  - f) Electric consumption is hard to monitor and control and people do not understand how electricity consumption is monitored and charged for;
  - g) Electrical appliances are not multifunctional and expensive to buy and repair;
  - h) Paraffin and coal have personal and cultural associations (as explained above);
- Respondents highlighted other advantages such as:
- i) It is fast (compared to electricity) and coal stoves. It is ready immediately to cook or heat water;
  - j) You can control the size of the flame, and
  - k) You can borrow paraffin from neighbours when you do not have sufficient funds to buy it.

The NOVA database shows that approx. 20 litres of paraffin per month are still consumed by households in an electrified area.

### 5.1.2 *Other Users*

Apart from the mothers and older girls that are responsible for cooking and buying fuel, some males are also using paraffin. Due to the nature of employment in the region, there is a significant number of single male households or tenants. They are either working or seeking work, and usually return late in the afternoon to their homes. Paraffin is in these circumstances a very convenient and fast fuel.

## 5.2 **End user reaction to the *Origo 3000 stove***

Households responded as follows:

### 5.2.1 *Physical characteristics*

The first reaction from families was that they thought it was an electric or LP Gas stove. They are impressed with the appearance and stainless steel finishing of the stove. Visitors to the ten families were so impressed that they came to the Sizanani centre to enquire about the stoves and to become part of the research.

All participating households were satisfied with the size of the stoves. Pots fit properly on the stove. The stove can be conveniently placed on a table and stored after use.

The stove is much more stable with a broad base and a lower centre of gravity than paraffin stoves.

The knobs of one stove were exposed to the heat from the burners and became brittle. Upon further investigation it was found that the table where the stove was used was not level (the floor of the shack is not level). The stove operated at an angle of  $\approx 5^\circ$  for extended periods of time.

Knobs became hot during continuous usage. Some respondents burned their fingers and others were concerned that the hot knobs may burn children's fingers.

### **Discussion:**

- Households regard the *Origo 3000 stove* as a durable product. Modifications to the stove to reduce the cost should not be at the expense of quality. Paraffin stoves sell at between R20 (single plate) and R45 (double plate) but last only approximately six months. Households should therefore get at least five years service from a stove if it costs approx. R400.
- Continuous utilisation at an angle, combined with a draft, may damage the stove or parts thereof.
- Safety instructions should include a note on levelling the stove.
- The knobs should be adapted.

#### *5.2.2 Functional characteristics*

##### a. Usage

Some households use a 20 litre boiler to prepare hot water for washing. The grid of the *Origo 3000 stove* is not able to hold the boiler. The diameters of the boilers vary between 250 mm and 300 mm. 20l pots with a diameter of 450 mm are used on special occasions.

##### b. Durability

The durability of the absorbent material in the containers was questioned. Respondents were also not sure how long the stove will last, especially smaller parts such as the knobs.

##### c. Safety

The safety of the stove was highly desirable. Households immediately recognised the safety advantages of the stove:

- It is much more stable than paraffin stoves.
- It cannot spill fuel when filled correctly.
- Water will extinguish flames.

##### d. Filling

Households did not experience any problem with the filling procedure of the tanks, except that it is not convenient to them. Fuel easily spills on their hands and this is perceived as hazardous. To ensure the correct amount of fuel, households poured the fuel into a 500ml container which is then used to fill the tanks. The use of the 500ml container decreased the risk of overfilling but this is an item that requires further attention.

##### e. Heating power

Households were impressed by the heating power. The *Origo 3000 stove* performed much better than paraffin stoves. One family prepared “mahlamhodi / binnegoed”<sup>1</sup> on the *Origo 3000 stove* and on a paraffin stove. The meal on the *Origo 3000 stove* were ready by 16:00 but the paraffin stove took another two hours before the meal was ready. (Total cooking time of the meal on the *Origo 2000 stove* was three hours.)

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<sup>1</sup>The intestines of an animal that requires a long cooking period.

f. Operating time

Operating time is similar to that of paraffin stove (1,2 / 4h). Families are used to consume between one and two litres of paraffin per day. Some families complained that they encountered problems when the fuel is depleted before the food is done. (Paraffin stoves can be refilled while cooking.)

g. Fuel economy

Most of the respondents used slightly more fuel in the *Origo 3000 stove* than in paraffin stoves, even though cooking time was faster. However, some respondents found better (than paraffin) results when cooking at low settings. One respondent set the knob on "1" for cooking. "This stove does not waste fuel" was her response.

h. Lighting procedure

Families complained the most about the lighting procedure. Because the burners are deep, ordinary matches are too short to light the stoves and respondents burned their fingers. Respondents used papers to light the stove, resulting in residue falling onto the absorbent material.

i. Burning characteristics

Respondents were very impressed by the clean burning of the stoves. It does not smell like paraffin or stain the pots. The "red" flame (when lighting) and the "blue" flame have positive connotations compared to a "green" flame associated with carbon monoxide. At first some families encountered problems when switching of the stoves. After prolonged use, the flame kept burning after the stove was switched of. The soon learned to open it again and then close it fast.

j. Cost

When asked about the cost of a similar stove, respondents expressed their willingness to pay between R150 and R200 for the stove. In the group discussions respondents were prepared to buy the stove for R200 to R300 if the fuel is affordable. They expect the stove to last for two to three years.

When a price of between R300 and R400 was mentioned, all but two respondents were still willing to buy the stoves. These respondents said that, because they are unemployed, they will not be able to afford it, even though they would like to buy it.

Respondents proposed a financing scheme to enable people to buy a stove.

**Discussion:**

- Safety is the most desirable aspect of the *Origo 3000 stove*.
- The method of filling can be improved but the price of the stove should not be increased by the improvements. It cannot be guaranteed that, during mass marketing, all households will continue using the proper filling method.
- Slightly larger tanks will increase cooking time but may also result in the storage of larger fuel containers indoors, increasing the risk to families.
- Knobs can be modified to turn more difficult at higher settings.
- A guarantee of 5 years on the *Origo 3000 stove* will provide peace of mind and reassure buyers.
- Households should be able to buy the stove with instalments.

### 5.3 Modification proposals

a. Grid

The grid should be adapted to provide extra support to carry at least 20kg.

b. Tanks

Respondents experienced that, when preparing slow and long cooking meals like “pap” (maize meal porridge) it happens that the stove runs out of fuel. They then have to wait for the stove to cool down before refilling it. Slightly larger tanks may solve the problem. The research assistants proposed that the instructions also include a note that the tank should be filled before time consuming meals are prepared.

c. Filling of the tanks

If possible, filling procedures should be simplified as spilling does occur during filling.

d. Lighting

Long matches are too expensive for poorer families. The lighting of the stove should be adapted in such a way that ordinary matches can be used. One proposal was that a wire with absorbent material in front, which can be dipped in the fuel, can be included with the stove.

e. Levelling

Safety instructions should include a reference that the stove should be level.

f. Knobs

Knobs can be modified to turn more difficult at higher settings. The knobs can be extended by approx. 5cm to prevent it becoming hot. If a slider is used, a scale should be provided

g. Ovens

Some households requested models with ovens. They would, however, first like to verify the size, price and quality of a model with an oven.

h. Safety instructions

Safety instructions should include a note of the distance between the stove and flammable material such as curtains.

### 5.4 End user perceptions of methanol fuel

Methanol was distributed to families in five litre containers. The first batch was not marked properly and safety signs and safety instructions (in English and isiZulu) were added by NOVA. The second batch had additional markings.

Families had to hand in the empty container (to prevent the use of the container for other purposes) in order to receive a full container.

#### 5.4.1 Perceptions

Methanol was perceived to be “as dangerous” as paraffin. “We know how to handle these types of fuels” was the reaction from one household. The respondents were concerned that someone may accidentally put the fuel in a paraffin stove.

#### 5.4.2 Containers

The five litre containers were very convenient for the respondents. However, they will not be able to always afford five litres of fuel at a time. Respondents proposed that semi-transparent containers should not be used as this may increase the risk of children becoming curious about the fuel.

Households prefer containers of one, two or five litres. The quantity that will be bought will depend on the available budget and storage facilities.

#### 5.4.3 Storage

Households stored the fuel in a similar manner as paraffin, i.e. either on a high shelf or under the bed to prevent children reaching it.

#### 5.4.4 Colouring

There was a difference in opinion amongst respondents about the colour of the fuel. Most of the respondents requested the fuel to remain the same colour “since we are used to the colour of paraffin”. One proposed that it should be the same colour as petrol or blue.

#### 5.4.5 Denaturants

Respondents did not complain about any negative effect of the denaturants (e.g. leaving a bitter taste on groceries). When asked about the smell of the fuel, one respondent said it “smells like methylated spirits”. The research assistants also felt that the fuel did not smell bitter enough to prevent accidental drinking.

All respondents stated that they wash their hands with soap after handling the fuel “because we know that fuel like paraffin is poisonous and it kills and hurts”.

#### 5.4.6 Concerns

Respondents and field workers raised some concerns regarding the potential future use of methanol:

- If it is cheaper than paraffin, households may use it in paraffin stoves.
- People may try to use it as stain remover or cleaning agent.
- Suicidal people may use it to commit suicide.

#### 5.4.7 Safety markings

Households indicated that they understand the safety markings classifying the fuel as hazardous. Fuel should, however also be marked in at least one of the local languages.

#### **Discussion:**

NOVA requested the project to be delayed until all safety regulations as specified by the SABS were addressed. Being a “new” fuel in the community the principle of due diligence should be followed when supplying communities with the fuel. This should include:

- Proper marking of all containers.
- The concentration denaturant should be sufficient to mask the distinctive methanol smell.
- Safety training of retailers and residents.
- Safety inspection of retail premises.
- Laboratory testing of the use methanol in paraffin stoves.
- If distribution takes place in small containers, childproof safety caps should be used.
- There should be no association with Methylated Spirits in naming, colouring or smell.
- Additional tests should be conducted to determine the most suitable colour and correct concentration of denaturant.

## 6. CONCLUSIONS

The *Origo 3000 stove* was highly desirable to the members of the participating households, and to visitors to the households. It is desirable for the following reasons:

- a. It is much safer than paraffin stoves and saves time.
- b. It is faster than paraffin stoves.
- c. The fuel does not smell like paraffin (when burning).
- d. Fuel consumption is low when used responsibly.
- e. The stove is of a high quality (stainless steel) and durable compared to paraffin stoves that lasts only six months.
- f. The appearance is aesthetically pleasing.
- g. It is a double plate stove.
- h. It does not make pots dirty.

Households are willing to buy the stove for a higher price than paraffin stove because of its safety characteristics and durability. There are, however reservations about the durability of especially the absorbent material and internal operating mechanism.

Methanol compares favourable with paraffin as a “traditional fuel” which strengthens the role of women and the interconnectivity of poor communities. Methanol can have a similar impact as paraffin and fire on community (see 5.1), and can fit into these patterns as a socially beneficial fuel (providing that the safety concerns are addressed and distribution and price is similar to paraffin).

Two critical issues came to the fore:

- i. The affordability of the stove. Although households are willing to pay a premium for safety and durability, they do have limited resources. The stove should therefore be as affordable as possible.
- j. The availability of methanol as a **safe fuel** in the community (i.e. safe retail storage and safe household storage). The flammability and toxicity of the fuel may pose problems during large scale distribution.



## 7. **RECOMMENDATIONS**

NOVA proposes that:

- a. The modification proposals should be considered.
- b. A second modified batch should be prepared and tested and validated by the same households.
- c. The long term durability of the *Origo 3000 stove* should be tested in selected households.
- d. The distribution method of the fuel should be investigated. Measures to mitigate potential risks associated with the flammability and toxicity of the fuel should be in place before the fuel is commercially available.

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