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# **FINAL REPORT**

*FOR*

**REDESIGN AND CONVERSION OF  
REFRIGERATION CYCLES OF  
APPLIANCES FOR ICE BLOCK  
MACHINES MODEL NOS. AK 00124B &  
AK 00128B AND MODEL NO. AN  
00121B CHILLER SYSTEM**

**AT**

**AKOCEN NIGERIA LIMITED**

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20TH NOVEMBER, 2002.**

## **INTRODUCTION**

This **FINAL REPORT** refers to the activities included between Steps 1 and 3 of the **UNIDO TERMS OF REFERENCES**.

The objective of the whole Project is to eliminate the use of CFC - 11 and CFC -12 in the production and service of **ICE BLOCK MAKING MACHINES** at Akocen Nigeria Limited through conversion to the use of **HFC 134a** and **HFC 404a** as Refrigerant and **HCFC - 141b** as **Blowing Agent in the Polyurethane Insulation Foam**.

It mainly consists in a summary of the logistic activities, Technical Services for the Re-design and Conversion of Refrigeration Cycles of appliances produced by **Akocen Nigeria Limited** as a follow up to Interim Progress Report dated 15th February, 2002 and Draft Final Report dated 1st July, 2002.

**AKOCEN NIGERIA LIMITED**  
**UNIDO PROJECT NO. MP/NIR/01/024**  
**FINAL REPORT**

**FOR REDESIGN AND CONVERSION OF REFRIGERANT CYCLES**  
**OF APPLIANCES OF ICE BLOCK MAKING MACHINES MODEL**  
**NOS. AK 00124B AND AK 00128B AND MODEL NO. AN 00121B**  
**CHILLER SYSTEM.**

The Redesign of the Refrigerant Cycles to **HFC 134a** and **HFC 404a** was carried out maintaining the equality of the Two Model Nos. **AK 00124B** and **AK 00128B Ice Block Making Machines** as well as Model **NO. AN 00121B Chiller System** produced at Akocen Nigeria Limited, especially with regard to the cooling capacity and energy consumption.

**AIMS AND OBJECTIVES:**

We have achieved our main aim of using both **R 134a** and **R 404a** as a cooling medium and the production of prototype and testing of the whole system. Our objective of making production involving optimized costs is also achieved.

**REDESIGN:**

We have successfully sourced components locally taking into consideration the utilization of Nigeria made components. The Evaporators for the Primary Systems have been redesigned with “5/8” copper pipe and the length of the piping tube was increased.

The inner Brine Tank thickness was increased to 2mm. The Insulation thickness of 100mm was maintained and converted to **HCF 141b Blown Polyurethane Foam**. The Lid Foam thickness of 50mm is still being maintained and retained for the 2 No. Models **AK 00124B** and **AK 00128B Ice Block Machines** whilst the thickness for the double doors of the **Chiller System Model NO. AN 00121B** was reduced to 35mm. The Temperature of 20°C applies to all the units including the **Chiller System**.

The 3 Nos. Electrical Panels have been redesigned. The Cabinet and the Ice Cans were duly produced with **HCF 141b Blown Polyurethane Foam** used for the cabins. We produced and installed these **Model No. AK 00124B - Ice Block Machine** as well and **Model No. AN 00121B Chiller System** for the

following customers whose addresses are given here below for reference purpose.

1. **MODEL** NO. 00124B  
**ADDRESS WHERE THE UNIT IS INSTALLED:** Plot 5, Okija Street,  
LASU - Igando Road,  
Obadore, Lagos.
  
2. **MODEL NO.** AN 0021B.  
**MAKE:** CHILLER SYSTEM.  
**NAME OF OWNER:** IKOYI CLUB 1938.  
**ADDRESS WHERE THE UNIT IS INSTALLED:** No. 6, Ikoyi 1938 Road,  
Ikoyi, Lagos, Nigeria.
  
3. **MODEL NO.** AK 00128B  
**MAKE** 98 MOULDS ICE BLOCK M/C.  
**NAME OF OWNER** KORTAH NIGERIA  
ENTERPRISES.  
**ADDRESS WHERE THE UNIT IS INSTALLED** Block 445, LSDPC Estate,  
Amuwo-Odofin, Lagos.

Photographs of the Units are enclosed here in for ease of reference.

**EVAPORATOR AND CONDENSER PERFORMANCE:**

**Re-134a** compared with **R-12** has a better thermal conductivity, higher latent heat and higher coefficient by heat transfer.

The specific volume of the vapour however is greater as the evaporation temperature falls below +5°C.

The same size of condenser have been used for the system as in those for **R-12** Maximum condensing temperature during stable condition of 60°C at 43°C ambient temperature. The evaporator for Model No. **AK 00121B** was converted to **New Chiller System**. The evaporator for Model No. **AK 00128B** have also been utilized for m/s KORTAH NIGERIA ENTERPRISES.

Pressure drops in both evaporator and condenser is less than that of **R-12** and **R-502** when **R-134a** and **R-404a** were used respectively for the new systems.

**R-134a** and **R-404a** are not miscible with the traditional mineral oils and as such, polyester oil have been used. All these evaporators were submerged in liquid (brine) and Chiller evaporator were hanged.

#### **FILTER DRIER:**

Due to the hygroscopic properties **R-134a**, and **R-404a**, it has become necessary to use filter drier stronger than that of **F-12** and **F-502** with at least 1.5 capacity more. To this effect, the convectional drier of **F-12** for **Model 0128B** and **0124B** was replaced with **R-134a XH7** and **XH9** while **MODEL 0121B Chiller System** with **F-502** drier was replaced with **R-404a** drier.

#### **LEAKAGES AND LEAK TESTING:**

Because of **R-134a** physical properties it tends to leak easily than that of **R-12**. All welded joints were carefully inspected for leaks. To achieve a better result, we have used the **VULKAN AN134** leak detector received from UNIDO to cross check all the joints. Traditional leak detectors search for chlorine and react against it. Therefore, they could not be used because there are no chlorine in **R-134a**. **R-134a** is fluorinated Hydrocarbon. All the three systems were leak tested prior to charging the Refrigerator **134a** and **404a**.

#### **CLEANLINESS:**

Cleanliness of the plant is associated with the experience of the initial installation and its subsequent need for servicing other than routine.

The procedure for new **R-134a** and **404a** plant are more stringent than those used for **R-12** and **R-502**, attention being drawn particularly to good evacuation and charging.

#### **EVACUATION AND CHARGING:**

All the system were completely evacuated for removal of air and moisture. We have been made to understand that HFC 134a system will be somewhat less tolerant to contermination than CFC 12 which has always been relatively tolerant in range of adverse condition such as moisture, air and dirt. To this effect, reducing the system pressure sufficiently to allow the heat from the atmosphere to vapourize any moisture left in the system is necessary before

carrying out the charging process. We have use WICAM high vacuum pump and OYAMA charging board to charge and recharge all the systems in this report.

### **THE PRODUCT:**

**R-134a** is a non-flammable hydrofluoroalkane with zero ozane depletion potential. It has physical properties very similar to that of **F-12** and is most suitable for traditional application such as chiller, and general purpose higher temperature refrigeration.

### **PERFORMANCE:**

Efficiency of refrigeration system is dependent upon a combination of refrigerant properties and equipment parameters. The thermodynamic properties of the refrigerant, compressor design, size and evaporator design and condenser and heat exchange around the system, all influence the measured efficiency. Coefficient of performance (COP) was comparable to that obtained with **R-12**.

Power consumption by the system was reduced by 10% while there was a corresponding loss of refrigeration capacity. **R-134a** charged into our plants designed for **R-12** has performed satisfactorily delivering the system requirements in respect of refrigeration capacity and temperature control. In general, only minor adjustments to the expansion valve settings have been done. All nominal loss of refrigeration capacity has been accommodated within the operational parameters of the system.

### **ACKNOWLEDGEMENT:**

May we use this opportunity to thank the entire staff of **UNIDO** for the encouragement and financial supports accorded us to carry out this redesign assignment.

I also appreciate the effort of DR. R. OSHIMA and m/s .M. Latrech for their understanding.

Thank you all and God bless.

**ADE OBATAYO ODULAJA (8691)**

**AKOCEN NIGERIA LIMITED**  
**REDESIGN & CONVERSION**  
**DATA SHEET**

**CHILLER SYSTEM    ICE BLOCK MACHINE**

| S/NO. | MODEL                             | AN 00121B        | AK 00124B       | AK 00128B        |
|-------|-----------------------------------|------------------|-----------------|------------------|
| 1.    | Net Capacity Per day (btls & Ice) | 800 btls         | 863             | 1,806            |
| 2.    | Cabinet Wall thickness (mm)       | 50               | 100             | 100              |
| 3.    | Lid Foam thickness (mm)           | 35               | 50              | 50               |
| 4.    | Temperature °c                    | +5 °c            | -20 °c          | -20 °c           |
| 5.    | Time for making lee (hrs)         | Non frost        | 8hrs.           | 8hrs.            |
| 6.    | Power Consumption (amps)          | 3.8              | 6               | 7                |
| 7.    | Noise Level dB                    | 38               | 38              | 40               |
| 8.    | Voltage/50HZ                      | 220              | 380             | 380              |
| 9.    | Compressor Power Rating HP        | 2                | 4               | 5                |
| 10.   | Inner Liner Material for Cabinet  | Aluminium        | Metal           | Metal            |
| 11.   | Inner Liner Material for Door/Lid | Aluminium        | Metal           | Metal            |
| 12.   | Condenser Type                    | Air cooled (fan) | Air cooled(fan) | Air cooled (fan) |
| 13.   | Condenser: tube diameter (mm)     | 4.4              | 4.4             | 4.4              |
| 14.   | Condenser, dimension tube (in)    | 5/8              | 5/8             | 5/8              |
| 15.   | Evaporator (coiled Eva): dia      | 620 x 4          | 2,100 x 2       | 2,100 x 2        |
|       | Lenght in mm                      | 500 x 4          | 1,900 x 1       | 1,960 x 1        |
| 16.   | Cooling System                    | Chilling Evap.   | Brine Solution  | Secondary System |
| 17.   | Refrigerant Type                  | R- 404a          | R 134a          | R 134a           |
| 18.   | Refrigerant Charge kg             | 3.66             | 4.86            | 9.83             |
| 19.   | Drier Type                        | 404a             | 134a Hx7        | R 134a Hx 9      |





