

**PCB**  
CONTAMINATION

**ON TRANSFORMERS IN**  
**INDONESIA**

**TREND ANALYSIS ON**  
**NATIONAL PCB**  
**INVENTORY DATABASE**

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PCB IDENTIFICATION & INVENTORY

PCB MANAGEMENT PLAN

A ROADMAP TO SOUND  
**MANAGEMENT  
AND DISPOSAL**

PCB INVENTORY MUST BE ACCOMPLISHED  
**BY THE END OF 2025**



WHAT ARE THEY?



WHERE ARE THEY?



HOW MUCH ARE THERE?



HOW DID PCB GET THERE?



## PCB CONTAMINATION TREND

PATTERNS AND/OR LIKELINESS OF  
PCB PRESENCE (PCC  $\geq$  50 PPM) IN  
TRANSFORMERS (AND CAPACITORS)....



BRAND OF DIELECTRIC OIL

YEAR OF PRODUCTION  
COUNTRY OF ORIGIN



BRAND OF TRANSFORMERS



## PCB-TRANSFORMER MANUFACTURERS

*World's Known Producer:*

USA: WESTINGHOUSE, GENERAL  
ELECTRIC COMPANY, RESEARCH-COTTRELL,  
KUHLMAN ELECTRIC CO  
GERMANY: AEG, TRAFU UNION

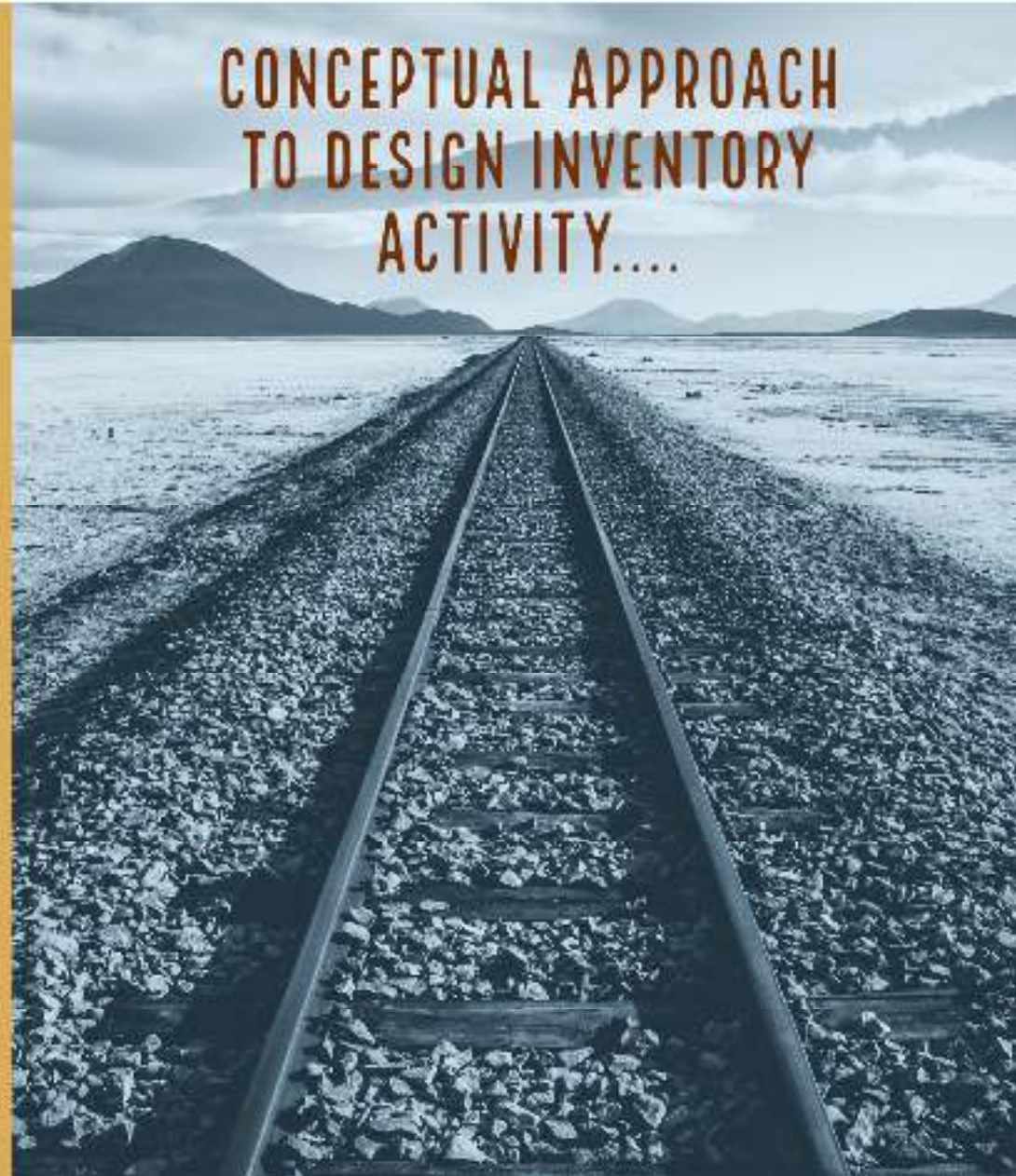


## PCB MIXTURES

*World's Known Brands:*

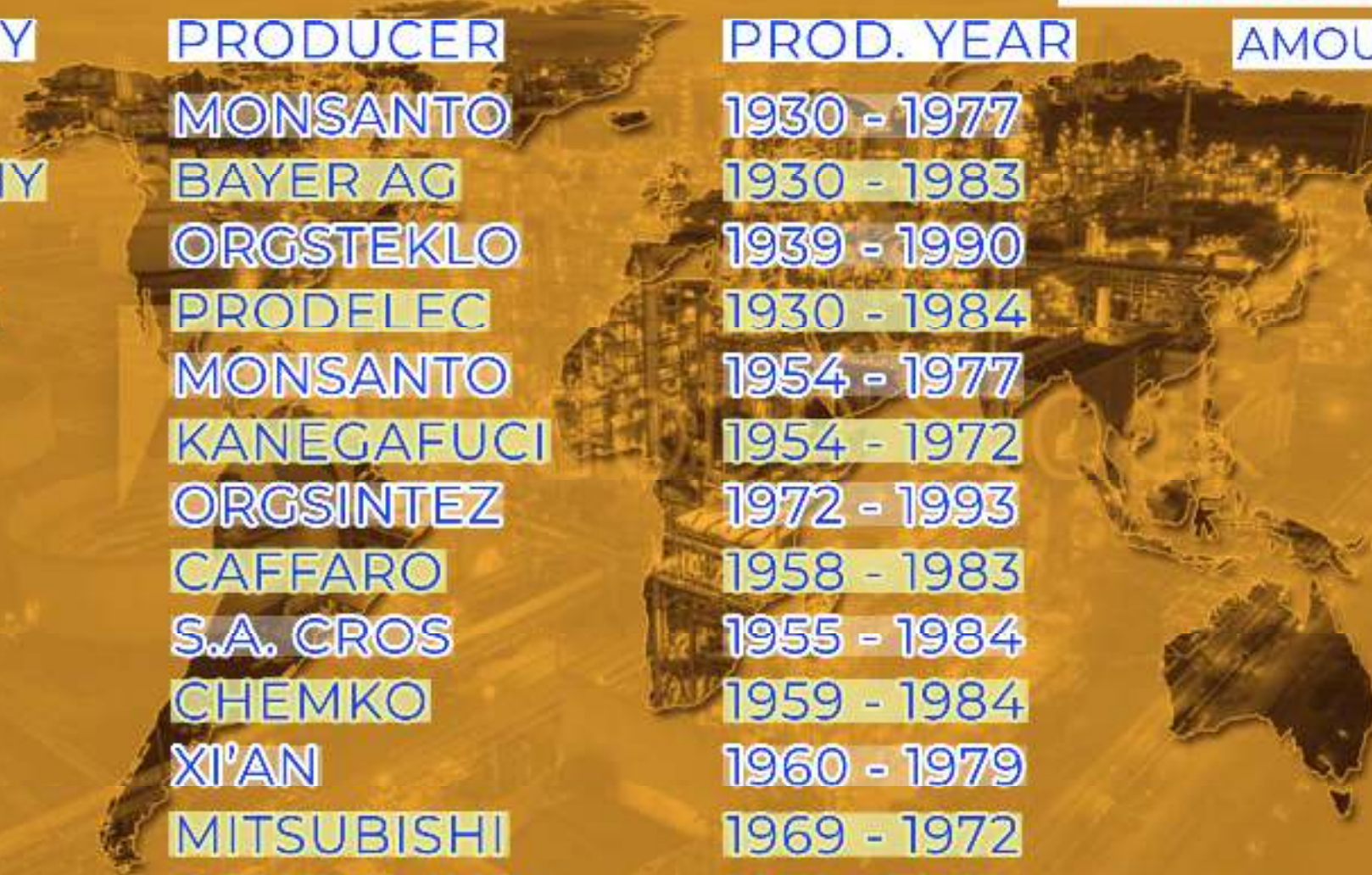
ACECLOR, ADKAREL, BAKOLA, BICHLOR  
CHLOREXTOL, CLOPHEN, DELOR, DIALOR  
ELECTORPHENYL, ELEMEX....  
SAFT-KUHL, SANTOVAC, TERMINOL, ETC....

CONCEPTUAL APPROACH  
TO DESIGN INVENTORY  
ACTIVITY....





GLOBAL PRODUCTION:  
> 1,300,000 TONS



COUNTRY	PRODUCER	PROD. YEAR	AMOUNT (TONS)
USA	MONSANTO	1930 - 1977	641,246
GERMANY	BAYER AG	1930 - 1983	159,062
SOVIET	ORGSTEKLO	1939 - 1990	141,800
FRANCE	PRODELEC	1930 - 1984	134,654
UK	MONSANTO	1954 - 1977	66,542
JAPAN	KANEGAFUCI	1954 - 1972	56,326
SOVIET	ORGSINTEZ	1972 - 1993	32,000
ITALY	CAFFARO	1958 - 1983	31,092
SPAIN	S.A. CROS	1955 - 1984	29,012
CZECH	CHEMKO	1959 - 1984	21,482
CHINA	XI'AN	1960 - 1979	8,000
JAPAN	MITSUBISHI	1969 - 1972	2,461
USA	GENEVA IND.	1971 - 1973	454

#17280454



**INVENTORY CARRIED OUT BY:**  
**MINISTRY OF ENVIRONMENT AND FORESTRY, INDONESIA**  
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**6 PROVINCES**

**> 1,000  
COMPANIES**

**> 3,000  
TRANSFORMERS**

**365  
DAYS**



**RAPID TEST**  
**POTENTIOMETRY (PPM)**



**5%**  
**> 50 PPM**

**80%**  
**CONSISTENT**

**82%**  
**CONFIRMED**

**GC-ECD**  
**IEC 61619**



# INDONESIA

CONTAMINATION TRENDS

3.7% OF TOTAL SAMPLES

50 - 400K PPM

POWER RATING > 100 KVA

27%  
KNOWN  
COUNTRIES

GERMANY

USA

FRANCE

CHINA

ITALY

JAPAN

73%  
NON-PRODUCER  
COUNTRIES

I.E. INDONESIA

2%  
KNOWN OIL  
BRANDS

CLOPHEN

98%  
MINERAL  
OIL

IEC 60296  
IEC 60422

2%  
KNOWN  
TRANSFORMER  
BRANDS

GENERAL ELEC. CO

TRAFO UNION

98%  
NON-PCB  
BRANDS

6%  
"HISTORICAL"  
PCB

YOM. BRANDS,  
COUNTRIES,  
MANUFACTURERS

94%  
PCB  
CONTAMINATED

PCB <  
15,000 PPM





## NUMBER OF TRANSFORMERS CROSS-CONTAMINATED BY PCB

"UNITED NATIONS ENVIRONMENTAL PROGRAMME.  
2002. PCB TRANSFORMERS AND CAPACITORS  
FROM MANAGEMENT TO RECLASSIFICATION AND DISPOSAL"

**45%**  
IN EUROPE

### THERE ARE TWO DIFFERENT REASONS WHY

A TRANSFORMER MAY CONTAIN PCB: (1) THE TRANSFORMER WAS DESIGNED AND BUILT TO BE USED WITH A PCB OIL AND (2) EXPERIENCE HAS SHOWN THAT MANY TRANSFORMERS SOLD, OR LABELLED, AS NON-PCB CONTAIN PCBs BECAUSE USING OIL CROSS-CONTAMINATED BY PCB.

"MAINTENANCE PRACTICES [....] TO REMOVE WATER & OTHER IMPURITIES. IF THE SAME MACHINES ARE USED [....] CROSS CONTAMINATION [....] WOULD OCCUR CAUSING THE CLEAN TRANSFORMER ALSO TO BECOME PCB-CONTAMINATED."

"LUCIANO GONZALES,  
PHD - PCB ELIMINATION  
NETWORK (PEN)  
MAGAZINE IN 2010"



CROSS-  
TAMINATION

Adobe S

TODAY

# RETROFITTED TRANSFORMERS



27%  
YES



37%  
NO



36%  
N/A

# YEAR OF MANUFACTURE



73% > 1982



25% <= 1982



3% N/A



# CONCLUSIONS

OF 3,000 SAMPLES 3.7% TRANSFORMERS CONTAINED PCB  $\geq$  50 PPM

PCB LEVEL RANGED FROM 50 - 400,000 PPM

ALL PCB TRANSFORMERS WERE > 100 KVA

6% PCB TRANSFORMERS MATCHED "HISTORICAL PROFILES" OF PCB

94% PCB TRANSFORMERS WERE RELATIVELY RECENT BETWEEN 1983 - 2012

MAINTENANCE PROCESS MIGHT BE RESPONSIBLE FOR RECENT CASES OF PCB CONTAMINATION





**PCB**

CONTAMINATION

**IN TRANSFORMERS  
IN INDONESIA**

**THANK YOU**  
FOR YOUR KIND ATTENTION

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