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Numerous verbal verifications by site technicians: mid December 1998.

WINS Impactor Oil crystallization first documented on 1/25/99.

Continued verbal and written confirmations for next three months.

Following PM2.5 Audits: Impactor oil found crystallized

March 17	New Haven State St.	Reg, Colo, SPM
March 18	New Haven Stiles St.	Reg, Colo
March 23	Danbury WCSU	Reg
March 23	Waterbury Shelter	Reg, Colo

Waterbury: Crystallization and gelling occurring only 1 hour after new oil, filters and wells installed. Ambient Temperature at time of Waterbury audit: 10.2°C (50.4°F).

Dow Corning Contacted.

**“Formula 704 Diffusion
Pump Fluid can
crystallize under rare
and undefined conditions
below 21°C (70°F).”**

“Crystallization is probably initialized at temperatures near 0°C (32°F), possibly assisted by dissolved moisture. Once started, an entire container could turn solid.”

“Fluid that has crystallized would have to be melted and *re-orientated* by holding for several hours at temperatures above 50°C (122°F). Otherwise the fluid could undergo re-crystallization at temperatures up to 20°C (68°F).”

Norm Beloin
EPA Region I

Frank McElroy
Office of Research & Development
EPA Research Triangle Park

Dr. Robert Vanderpool
EPA Contractor (ORD)
Research Triangle Institute

**WINS Impactor Oil Special Study set up at
the DEP Lab Facility April 5 - May 13,
1999**

**No crystallization of either the Fisher
Scientific or R&P oil was observed during
this study.**

**R&P oil stored at DEP Lab:
No crystallization or gelling.**

**Intermittent gel spots occurred when R&P
oil from one of our field sites used.**

Nye Synthetic Oil 435

Replaces previous oil in field.

**Issued to site technicians in
mid December 1999.**

**Bottles stored at site shelters,
which maintain an inside
temperature of 70-80°F.**

**Crystallization resurfaced
late December 99**

6 Audits performed on Dec. 30

Confirmed crystallization.

Stiles St: Impactor oil replaced
several hours earlier.

Ambient Temperatures: 37-50°F.

**Crystallization worsened
January 2000.**

New QA Procedures Initiated

Site technicians required to inspect the WINS impactor at every site visit.

If the oil is crystallized, the impactor well must be cleaned or replaced, and new oil and filter installed.

Site technicians must document the condition of the oil and the corrective action taken on the PM_{2.5} Data Sheet.

**Majority of states do not
service the WINS impactor at
the sampling site.**

WINS impactor swap.

**WINS impactor may not be
opened for several hours or
even days.**

Extremely important for site operators to perform a visual inspection of the WINS impactor being changed at time of the swap.

Crystallization may be occurring without site operators realizing it.

**Dr. Wayne Chatterton
Organosilicone Chemist
Dow Corning**

**Numerous complaints: Formula 704
Involve usage of fluid in applications
other than it was intended for.**

**Formula 704 was primarily designed
for use in diffusion pumps and
temperatures above 250°F.**

**Limited Warranty -
Please Read Carefully**

“It is your responsibility to thoroughly test the product in your specific application to determine its performance, efficiency and safety.”

**Dr. Chatterton suggested
“doping” Formula 704 with
either Formula 702 or 705.**

Ratio of 10/1

**This addition of Formula 702
or 705 lowers the
crystallization point of 704
without significantly altering it.**

Packaging, Storage and Shelf Life

Formula 704 is packaged in a number of ways depending on whom it is purchased from.

Clear Plastic	Colored Plastic
Colored Glass	Metal Container

“When stored in the original, sealed container at or below 25°C (77°F), Dow Corning Formula 704 has a shelf life of 5 years from the date of manufacture. No inherent limitations on the useful life of this product are known to exist.”

Crystallized Oil Reported:

Connecticut

Michigan

New York

North Dakota

Pennsylvania

Wisconsin

PEP Audits: Regions 1, 2, & 10

Tom Enright: Field Scientist
PEP Audits: Region I

**Reports at least one episode of
crystallization (BGI Sampler)
in every New England state
during 2000 PEP Audits.**

**No crystallization of oil during
1999 PEP Audits.**

Special Studies

A. Impactor Oils

- 1. Dow Corning Formula 704
(BGI, RTI, Lockheed, R&P)**
- 2. Nye Synthetic 435**
- 3. Formula 704/705 Blend**
- 4. Invoil 705**
- 5. Invoil-S**

B. Impactor Oil Filters

- 1. Pallflex (R&P)**
- 2. Whatman (RTI)**
- 3. Gelman (BGI)**

C. Impactor Wells

- 1. R&P**
- 2. BGI**
- 3. Andersen Instruments (RI)**

Current Special Study

Started 4/13/2000

4 R&P single filter samplers.

Formula 704

**Crystallized Formula 704
(Impactor well no oil/no filter)**

Invoil-S

Sharp-cut Cyclone

Conclusion: More Questions than answers.

Dow Corning, manufacturer of Formula 704, confirms the crystallization problem.

Temperature below 21°C, relative humidity, and possibly environmental factors responsible (Not just 1 factor).

Some states seeing crystallization, others not.

Impactor oil may be crystallizing between inspections without anyone seeing it.

How is the PM_{2.5} cut-point affected?

Solutions: Replacement oil, Sharp-cut cyclone.

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