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# CAMEO Chemicals: a Guided Tour

Take this guided tour to master the features and capabilities of the CAMEO Chemicals website (<http://cameochemicals.noaa.gov>). The tour takes you step-by-step through a series of fictional emergency scenarios.

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## About CAMEO Chemicals

CAMEO Chemicals includes a searchable database of more than 6,000 hazardous materials (with over 80,000 trade names and alternate names). You can search the database for chemical data sheets using each chemical's name, ID number, or other identifiers. Each chemical's data sheet contains a general description of the chemical, its physical properties, fire and health hazards, and recommendations for firefighting and non-fire response, first aid, and protective clothing for responders. The information in the chemical data sheets was compiled from a variety of documents and databases, each prepared by a different organization such as the American Association of Railroads or the EPA. CAMEO Chemicals also includes a worksheet for predicting potential reactivity between two or more chemicals.

CAMEO Chemicals is the online version of the hazardous chemicals library included in the CAMEO (Computer-Aided Management of Emergency Operations) software suite. The CAMEO suite is used by emergency responders and planners around the U.S. and elsewhere in the world. It was developed by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency, with support from the U.S. Census Bureau and the U.S. Coast Guard. You can learn more about CAMEO or download a free copy of the software at <http://www.epa.gov/ceppo/cameo>.

CAMEO Chemicals was developed by NOAA with support from the U.S. Coast Guard.

## An Early Start to a Busy Day

Imagine that you're a marine science technician at U.S. Coast Guard Sector River City. You've barely started your shift when the operations specialist at the command center alerts you to a report of an abandoned steel drum that has washed up at the local picnic beach.

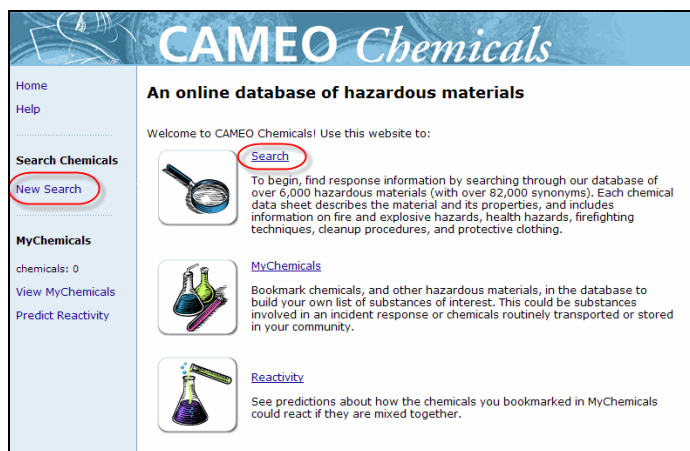
The only identification on the drum is the stenciled product name, "slimicide." It's a closed-top drum with a small bung on its top.

What could be in the drum, and how hazardous might it be? The officer in charge wants to know, and wants a printout of information about the drum's contents.

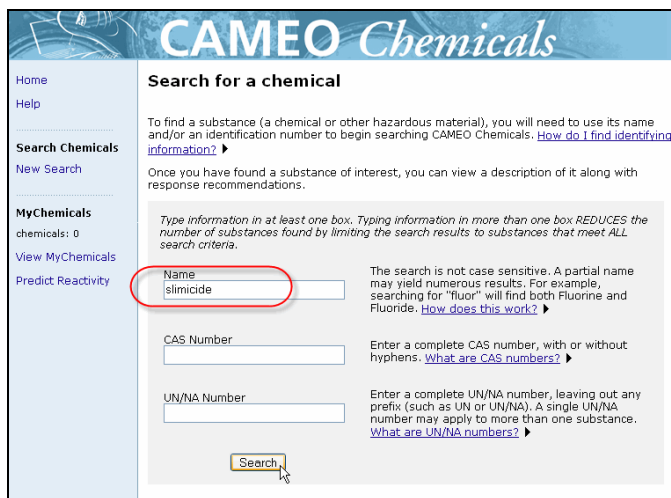
# Identifying a chemical and assessing its hazards

Your first actions are to open CAMEO Chemicals and search for the chemical:

1. Start your web browser and open CAMEO Chemicals:  
<http://cameochemicals.noaa.gov>.
2. To display the Search Page, click either **Search** or **New Search**.



3. Type "slimicide" in the Name box, then click **Search**. Notice that you can search CAMEO Chemicals for a trade name or common name like "slimicide," as well as for a proper shipping name or chemical name.



4. You'll see a results list that includes three chemicals that match your search criterion that the substance's name is "slimicide." Now you need to identify the best match from among those three chemicals.

CAMEO Chemicals tries to rank chemicals in the search results list so that the best matches are at the top. **Acrolein, inhibited** is at the top of this list. In fact, it's the best match for two reasons:

First, its alternate name, "slimicide," exactly matches the name on the drum:

**ACROLEIN, INHIBITED**  
A colorless to yellow volatile liquid with a disagreeable choking odor.  
**DOT Hazard Label:** FLAMMABLE LIQUID, POISON **Flash Point:** -15.0 ° F **LEL:** 2.8 %  
**ERPG-3:** 3.0 ppm  
**CAS Number:** 107-02-8  
**UN/NA Number:** 1092  
*This chemical is also known as:*  
• **SLIMICIDE**

[View Data Sheet](#) [Add to MyChemicals](#)

Second, the operations specialist reported that the drum is the closed-head type designed to hold liquids: the lid is not removable and it has a bung for pouring. A drum for solids would be the open-head type with a removable lid. So it's most likely that the drum contains a liquid. In the search results list, check the one-sentence description of each chemical. You'll see that acrolein is the only liquid in the list. The other two chemicals are solids.

**ACROLEIN, INHIBITED**  
A colorless to yellow volatile liquid with a disagreeable choking odor.  
**DOT Hazard Label:** FLAMMABLE LIQUID, POISON **Flash Point:** -15.0 ° F **LEL:** 2.8 %  
**ERPG-3:** 3.0 ppm  
**CAS Number:** 107-02-8  
**UN/NA Number:** 1092  
*This chemical is also known as:*  
• **SLIMICIDE**

[View Data Sheet](#) [Add to MyChemicals](#)

Just because acrolein is the best match doesn't mean you can be certain that's what's in the drum. You would want to further verify that it's acrolein in the drum, for example by having a contractor sample the drum's contents. But knowing that there's a good chance that the drum contains acrolein can help you to plan your response.

**Note:** The word **inhibited** in the name for this substance ("Acrolein, inhibited") means that when acrolein is transported or stored, an inhibitor chemical is typically mixed into it. Acrolein can react with itself—it's **polymerizable**. Self-reaction can generate a dangerous amount of heat that can cause a container to fail, or initiate a fire or explosion. The inhibitor added to a polymerizable substance like acrolein is a substance that slows down or prevents the polymerization reaction. Responders need to know that most inhibitors gradually break down over time, eventually losing the ability to prevent polymerization. In this case of an abandoned drum that may contain a polymerizable chemical with an out-of-date inhibitor, the entry team should be aware of the potential polymerization hazard.

5. Your next step is to assess other potential hazards of acrolein. Click **View Data Sheet** to see a report on this chemical.

**Search results**

Name **SLIMICIDE** matched 3 chemicals

1 - 3 of 3 results   Prev   Next   Page 1 of 1   Go to page:

**ACROLEIN, INHIBITED**  
A colorless to yellow volatile liquid with a disagreeable choking odor.  
**DOT Hazard Label:** FLAMMABLE LIQUID, POISON   **Flash Point:** -15.0 ° F   **LEL:** 2.8 %  
**ERPG-3:** 3.0 ppm  
**CAS Number:** 107-02-8  
**UN/NA Number:** 1092

This chemical is also known as:

- **SLIMICIDE**

6. The report contains six sections. To go to a particular section, you can either scroll down the page or use the quick links at the top of the page. To begin your hazard assessment, go to **Section 1 – Chemical Identifiers**.

7. First, check the NFPA 704 “diamond.” This simple graphic is designed to be a summary of the chemical’s main hazards. The three numbers in the blue, red, and yellow quadrants of the diamond are number codes indicating acrolein’s degree of health, flammability, and reactivity hazard. The codes range from 0 to 4, with 4 indicating the highest level of hazard. The white quadrant provides information about special precautions.

**Section 1 - Chemical Identifiers**

[Back to top](#) | [What is this information?](#) ▶

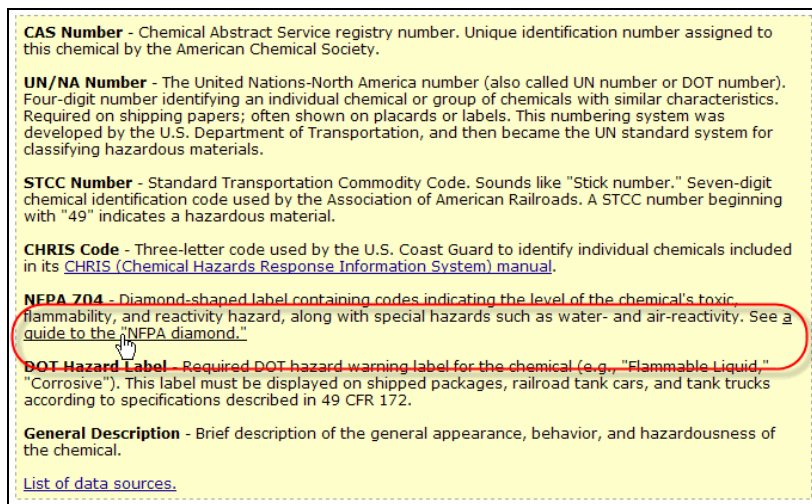
CAS Number	UN/NA Number	STCC Number
107-02-8	1092	4927007

**NFPA 704:** **DOT Hazard Label:** POISON  
FLAMMABLE LIQUID

If you aren't familiar with the NFPA codes, you can get an explanation from the online help system, as follows:

Click the **What is this information?** link at the top of Section 1. A yellow box drops down. It contains a short explanation of each kind of information shown in Section 1.

Next, click the link to **a guide to the "NFPA diamond."**



**CAS Number** - Chemical Abstract Service registry number. Unique identification number assigned to this chemical by the American Chemical Society.

**UN/NA Number** - The United Nations-North America number (also called UN number or DOT number). Four-digit number identifying an individual chemical or group of chemicals with similar characteristics. Required on shipping papers; often shown on placards or labels. This numbering system was developed by the U.S. Department of Transportation, and then became the UN standard system for classifying hazardous materials.

**STCC Number** - Standard Transportation Commodity Code. Sounds like "Stick number." Seven-digit chemical identification code used by the Association of American Railroads. A STCC number beginning with "49" indicates a hazardous material.

**CHRIS Code** - Three-letter code used by the U.S. Coast Guard to identify individual chemicals included in its [CHRIS \(Chemical Hazards Response Information System\) manual](#).

**NFPA 704** - Diamond-shaped label containing codes indicating the level of the chemical's toxic, flammability, and reactivity hazard, along with special hazards such as water- and air-reactivity. See [a guide to the "NFPA diamond."](#)

**DOT Hazard Label** - Required DOT hazard warning label for the chemical (e.g., "Flammable Liquid," "Corrosive"). This label must be displayed on shipped packages, railroad tank cars, and tank trucks according to specifications described in 49 CFR 172.

**General Description** - Brief description of the general appearance, behavior, and hazardousness of the chemical.

[List of data sources.](#)

The CAMEO Chemicals online help system opens in a new window, and displays the "Anatomy of the NFPA diamond" page. Review the discussion and the table showing the meaning of each number code. You'll see that acrolein is an especially dangerous chemical: highly toxic, flammable, *and* reactive.

8. Your next step in assessing acrolein's hazards is to review the general description of the chemical, also in Section 1 of the data sheet, as shown below. The general description includes the appearance and physical state of the chemical, its most significant hazards, and some key properties. Acrolein's general description warns you of its significant inhalation hazard:

<p><b>General Description</b> A colorless to yellow volatile liquid with a disagreeable choking odor. Flash point below 0°F. Initially irritating to the eyes and mucous membranes. Very toxic by inhalation. Less dense than water (7.0 lb / gal). Vapors heavier than air. Used to make other chemicals, plastics, and as a herbicide.</p> <p>Rate of onset: Immediate</p> <p>Persistence: Minutes to hour</p> <p>Odor threshold: 1 ppm</p> <p>Source/use/other hazard: Herbicide; tox and corrosive fumes. (NOAA, 2003)</p>
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**Note:** The statement "Vapors heavier than air" alerts you that the toxic vapor evaporating from spilled acrolein would stay near the ground and could collect in low areas, such as terrain depressions, stairwells, cargo holds, and storage tanks.

9. Now scroll down to **Section 2 – Hazards**. This section contains more detailed information about acrolein's hazards. It alerts you that acrolein is extremely toxic (see "Health Hazard") and polymerizable (see "Reactivity Alerts")—hazards you already discovered—and that it's also highly flammable and water reactive (reacts with water).
10. Scroll down to **Section 3 – Response Recommendations**, to view response and first aid recommendations. This section recommends how to fight a fire when acrolein is involved, how to handle an acrolein spill when there's no fire, how responders should protect themselves, and how to provide first aid if people are exposed to acrolein.
11. Scroll down to **Section 4 – Physical Properties**, to see some of acrolein's physical properties. Also listed are two toxic **levels of concern** (LOCs) for acrolein: **ERPG** (Emergency Response and Planning Guidelines) and **IDLH** (Immediately Dangerous to Life and Health). A toxic LOC is a concentration of a toxic gas in air, above which a threat to people may exist.

**Note:** In CAMEO Chemicals, a toxic LOC tells you what level (threshold concentration) of exposure to a chemical could hurt you or other people if you breathe it in for a defined length of time (exposure duration). Toxic LOCs also may be referred to as exposure limits, exposure guidelines, or toxic endpoints. Generally, the lower the toxic LOC value for a substance, the more toxic the substance is by inhalation. Acrolein's LOC values are very low because it is a highly toxic chemical.

A CAMEO Chemicals data sheet may include any of the following **public exposure guidelines**, depending on which have been defined for the chemical:

- **AEGLs** (Acute Exposure Guideline Levels)
- **ERPGs** (Emergency Response Planning Guidelines)
- **TEELs** (Temporary Emergency Exposure Limits)

These public exposure guidelines are designed to predict how the general public could be affected by a short-term release of a particular toxic chemical. Each has three tiers of exposure values (e.g., AEGL-1, AEGL-2, and AEGL-3) for each covered chemical. There are some key differences between the exposure guidelines, but at a very general level, the tiers are similar: the first tier (e.g., ERPG-1) is a detection threshold, the second tier (e.g., ERPG-2) is an escape impairment threshold, and the third tier (e.g., ERPG-3) is a life-threatening effects threshold.

**AEGLs** are considered the best public exposure guidelines to date, because they undergo a rigorous review process, and are designed as guidelines for nearly all members of the general public—including sensitive individuals. Final AEGLs have been defined for only a few dozen chemicals. **ERPGs** are based on experimental data, but unlike AEGLs they are only available for a 1-hour exposure duration and they are not designed as guidelines for sensitive individuals. By definition, **TEELs** are temporary limits designed to be used as exposure limits for chemicals for which AEGLs or ERPGs have not yet been defined.

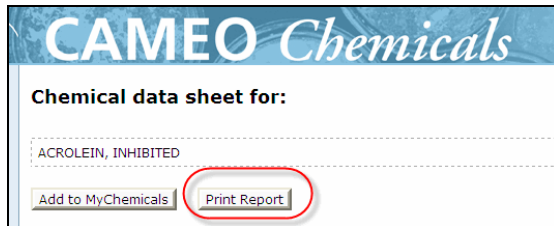
CAMEO Chemicals data sheets also include **IDLH** (Immediately Dangerous to Life and Health limit), which is a **workplace exposure limit**. Workplace limits are usually defined for healthy adult workers, and typically incorporate safety factors to ensure that workers won't be overexposed to hazardous chemicals in the workplace. IDLH is designed primarily for making decisions regarding respirator use. In the 1980s, before public exposure guidelines were available for most common chemicals, the IDLH limit was used in public exposure situations.

12. Scroll down to **Section 5 – Regulatory Information**. This section shows whether the chemical is listed under important environmental laws, and provides other information of interest to people managing or regulating chemical facilities. For example, acrolein's Reportable Quantity is listed in Section 5, as shown below. This is the quantity of a hazardous substance or extremely hazardous substance that, if released, must be reported to the National Response Center

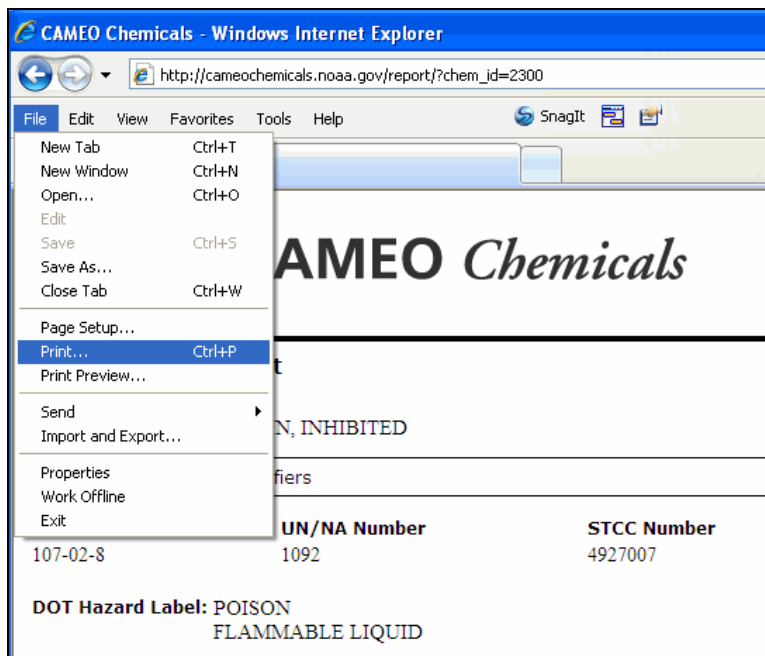
**CERCLA: Regulated chemical with a Reportable Quantity of 1 pounds.**

13. Scroll down to **Section 6 – Alternate Chemical Names** to view a list of names by which acrolein is known. The list typically includes trade names and names in languages other than English.

14. The officer asked for a printout of useful information. Click **Print Report** (at the top of the data sheet) to get a “printer friendly” page to print.



15. Choose the sections to include in the printout for the officer, then click **Preview Report**. The formatted report, including the sections you selected, appears in your browser window. Choose **Print** from your browser's menu to print the report.





## Developing a response strategy for a derailed tankcar

A contractor has been dispatched to the location of the abandoned drum to sample its contents and begin the disposal process. You've no sooner grabbed a cup of coffee than a report comes in to the command center: a train has just derailed at the Port of River City. The biggest concern is a derailed tank car.

An alert cargo inspector emails you the photo below, which she snapped with her phone camera:



The officer in charge, thinking ahead, wants to know whether it would make sense to dike the tank car to contain the contents, in case of a spill. There's no visible leak yet, but the full extent of the damage to the tank car isn't yet clear.

Also, a report from on scene indicates that some dry vegetation near the derailed train is smoldering. The officer also wants to know whether it would be safe to apply water if the tank car becomes involved in a fire. Many chemicals react with water, and in some cases that reaction can produce a hazardous gas (such as hydrogen cyanide or phosphine). It's not safe to apply water to such chemicals.

To get the answers to the officer's questions, your first step is to identify the commodity in the derailed tank car. Checking the inspector's photo, you can see that the tank car is placarded with a DOT placard—the diamond-shaped, black-and-white placard in the photo—and that the placard displays a number: 1824. This is the United Nations – North America (UN/NA) number for the commodity in the car. Each UN/NA number is a four-digit number that identifies an individual chemical or a group of chemicals with similar characteristics.

1. Click **New Search** in the left navigation bar. In the UN/NA Number box, type 1824, then click **Search**.

Type information in at least one box. Typing information in more than one box **REDUCES** the number of substances found by limiting the search results to substances that meet **ALL** search criteria.


Name <input type="text"/>	The search is not case sensitive. A partial name may yield numerous results. For example, searching for "fluor" will find both Fluorine and Fluoride. <a href="#">How does this work?</a> ▶
CAS Number <input type="text"/>	Enter a complete CAS number, with or without hyphens. <a href="#">What are CAS numbers?</a> ▶
UN/NA Number <input type="text" value="1824"/>	Enter a complete UN/NA number, leaving out any prefix (such as UN or UN/NA). A single UN/NA number may apply to more than one substance. <a href="#">What are UN/NA numbers?</a> ▶

2. This time, just one chemical meets your search criterion: **Caustic soda, solution**. Click **View Data Sheet** to find out about this chemical. You need to find out whether it's a good idea to dike the tank car, and whether it's recommended to apply water to it.

**Note:** What you don't know from the UN/NA number alone is the strength of the caustic soda solution in this tankcar. Caustic soda solution is made by dissolving sodium hydroxide (a strong base, also known as lye or caustic soda) in water. As with other solutions, the properties of caustic soda solution depend on solution strength—in this case, the amount of sodium hydroxide dissolved in the water. As a general rule, the stronger the solution of a hazardous chemical, the more hazardous the solution is. In the case of caustic soda solution, the most commonly transported grades are 50% and 75%—strong enough to be very hazardous.

3. Scroll to **Section 1 – Chemical Identifiers**, and check the NFPA diamond. For many water-reactive chemicals, "**W**" appears in the white quadrant of the diamond to indicate water reactivity. The white quadrant is empty, indicating that the chemical is not strongly water-reactive, but you'll want to check elsewhere in the data sheet to be more sure.

Also read the general description. It indicates that this substance is a thick liquid—a liquid probably could be contained by diking.

**NFPA 704:**  **DOT Hazard Label:** CORROSIVE

**No indication of water reactivity**

**General Description**  
A dark, thick liquid. More dense than water. Contact may severely irritate skin, eyes, and mucous membranes. Toxic by ingestion. Corrosive to metals and tissue. Density 13 lb / gal. (REACTIVITY, 2003)

4. Scroll down to **Section 2 – Hazards**. Review this section, especially the Reactivity Alerts, Air & Water Reactions, and Reactivity Profile areas, to learn more about the substance’s water reactivity and other possible hazards.

You’ll see that the caustic soda solution is somewhat water reactive, enough to possibly cause local boiling and splattering. Also note that it can severely burn people who come into contact with it. Make sure that responders approaching the tank car are aware of the potential burn hazard from splattering caustic soda solution.

**Reactivity Alerts**  
none

**Air & Water Reactions**  
Slowly absorbs carbon dioxide from the air to give solid products as crusts or precipitates. Water soluble. Dilution with water liberates heat, possibly enough to cause local boiling and splattering.

**Fire Hazard**  
Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. Some are oxidizers and may ignite combustibles (wood, paper, oil, clothing, etc.). Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated. (DOT, 2000)

**Health Hazard**  
Causes severe burns of eyes, skin, and mucous membranes. (USCG, 1999)

5. Scroll down to **Section 3 – Response Recommendations**. Review this section. Note that the Fire Fighting section recommends applying flooding quantities of water—further verification that applying water won’t generate dangerous water reactivity. Also note that the Non-Fire Response section recommends diking to contain flow.

Also note the protective clothing recommendations to protect responders from the potential burn hazard.

**Section 3 - Response Recommendations**

[Back to top](#) | [What is this information?](#) ▶

**Fire Fighting**  
Extinguish fire using agent suitable for type of surrounding fire. (Material itself does not burn or burns with difficulty. Use water in flooding quantities as fog. Apply water from as far a distance as possible. ((c) AAR, 2003)

**Non-Fire Response**  
Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Apply water spray or mist to knock down vapors. Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash or cement powder. Neutralize with vinegar or other dilute acid. Water spill: Neutralize with dilute acid. ((c) AAR, 2003)

At this point, you have the information that the officer requested: diking would indeed make sense if there’s a possibility of a leak, and it would be one way to keep the spilled solution away from water sources and sewers. Applying water is a recommended

response measure, as long as people in the immediate area are protected from splattering material.

Note that Section 3 provides other response recommendations beyond those the officer asked you to research. For example, the spilled caustic soda solution could be neutralized with vinegar or another dilute acid.

As an additional step, you might want to check other sources to further verify your findings.

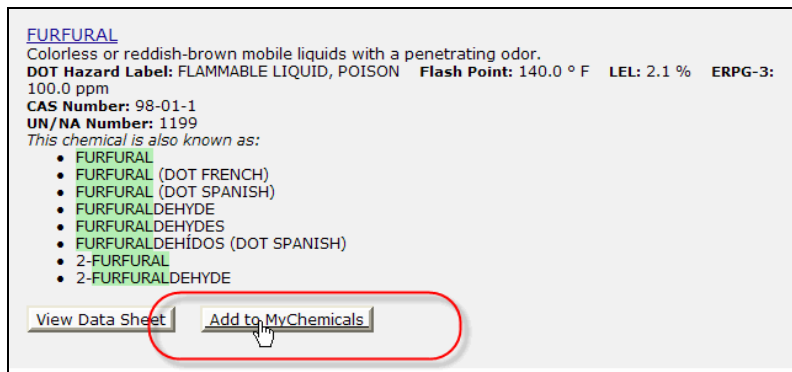
## Predicting potential reactivity

It's early afternoon now, and another call comes in to the command center. At the Port of River City, a container being handled at an unloading facility has just been accidentally dropped, and has spilled some of its contents. A USCG cargo inspector is onscene. He reports seeing 55-gallon drums of furfural, some of which are leaking, as well as cardboard drums holding thiourea powder, some of which have broken open.

There's a strong possibility that these chemicals could mix. The officer in charge wants to know whether they could react together, if they mix. She also would like a printout of information about the chemicals and their potential reactivity hazard (if any).

To find the information the officer needs in CAMEO Chemicals, you'll need to add both chemicals to **MyChemicals**, a virtual workspace where you can manage data sheets for many chemicals at once and predict the potential reactivity if the chemicals mix. Here's how to add these two chemicals to MyChemicals:

1. Click **New Search** in the left navigation bar. In the Name box, type "furfural" and then click **Search**.
2. Four chemicals match your criterion. Because the first chemical in the list, furfural, is an exact match to the name shown on the drums, it's the best match. Just below the information about this chemical, click **Add to MyChemicals**.



**FURFURAL**  
Colorless or reddish-brown mobile liquids with a penetrating odor.  
**DOT Hazard Label:** FLAMMABLE LIQUID, POISON    **Flash Point:** 140.0 ° F    **LEL:** 2.1 %    **ERPG-3:** 100.0 ppm  
**CAS Number:** 98-01-1  
**UN/NA Number:** 1199  
*This chemical is also known as:*

- FURFURAL
- FURFURAL (DOT FRENCH)
- FURFURAL (DOT SPANISH)
- FURFURALDEHYDE
- FURFURALDEHYDES
- FURFURALDEHÍDOS (DOT SPANISH)
- 2-FURFURAL
- 2-FURFURALDEHYDE

[View Data Sheet](#)    [Add to MyChemicals](#)

3. Again, click **New Search** in the left navigation bar. In the Name box, type "thiourea powder" and then click **Search**.

4. In this case, no chemicals match this search criterion. Troubleshooting tips are displayed, along with a link to more tips on a separate troubleshooting page.

One tip suggests using just part of a chemical's name in a search, if the full name turns up no "hits."

To try out this tip, click **modify your search**.

### Search results

Name **THIOUREA POWDER** matched 0 chemicals

**No matches were found.**

Check our [troubleshooting page](#) for tips on modifying your search.

Note: Often, no matches are found because of a misspelling in a chemical name. Some commonly misspelled names are:

- fluoride
- chlorine
- phosphorus
- potassium
- sulfur
- ethylene
- pyrophoric

Also, the chemical name search looks for the exact characters you typed into the search field. For example, searching "dimethyl chlorine" will NOT find "chlorine, dimethyl" because the punctuation and word order is different. In this case, search on just "chlorine."

Go back and [modify your search](#).

5. The search page is displayed, with "THIOUREA POWDER" in the Name box. Delete "POWDER" and then click **Search**.

Type information in at least one box. Typing information in more than one box **REDUCES** the number of substances found by limiting the search results to substances that meet **ALL** search criteria.

Name <input type="text" value="THIOUREA"/>	The search is not case sensitive. A partial name may yield numerous results. For example, searching for "fluor" will find both Fluorine and Fluoride. <a href="#">How does this work?</a> ▶
CAS Number <input type="text"/>	Enter a complete CAS number, with or without hyphens. <a href="#">What are CAS numbers?</a> ▶
UN/NA Number <input type="text"/>	Enter a complete UN/NA number, leaving out any prefix (such as UN or UN/NA). A single UN/NA number may apply to more than one substance. <a href="#">What are UN/NA numbers?</a> ▶

6. This time, 19 chemicals match your new criterion ("thiourea"). None is an exact match to the name you were given, "thiourea powder." But the first substance in the list, thiourea, is the best match because the name matches and the substance is found as crystals or powder. Just below the information about this chemical, click **Add to MyChemicals**.

**THIOUREA**  
White or off-white crystals or powder.  
DOT Hazard Label: KEEP AWAY FROM FOOD TEEL-3: 125.0 mg/m3  
CAS Number: 62-56-6  
UN/NA Number: 2811  
This chemical is also known as:  
• THIOUREA  
• 2-THIOUREA  
• ISOTHIOUREA  
• PSEUDOTHIOUREA

[View Data Sheet](#) [Add to MyChemicals](#)

Now both chemicals have been added to MyChemicals and you're ready to predict the potential reactivity, if they mix.

7. In the left navigation bar, click **Predict Reactivity**.

**Search Chemicals**  
New Search  
Modify Search  
Search Results

**MyChemicals**  
chemicals: 2  
View MyChemicals  
**Predict Reactivity**

8. The predicted reactivity between these two chemicals, if they were to mix, is shown in a red-bordered box on the Chemical Reactivity page. It's predicted that the reaction would be **exothermic**—that is, it would generate heat.

Click the two links directly below the red-bordered box (“What do these predictions mean?” and “What is chemical reactivity and how is it predicted?”) to learn how CAMEO Chemicals predicts reactivity.

Notice that CAMEO Chemicals’ predictions are general, and that it does not predict the byproducts of the reaction.

### Chemical reactivity

**Substances in the mix**

1. [THIOUREA](#)
2. [FURFURAL](#)

Go to [MyChemicals](#) to edit this list.

**Hazard predictions if these chemicals mix**

- Exothermic reaction. May generate heat and/or cause pressurization.

[What do these predictions mean?](#) ▶

[What is chemical reactivity and how it is predicted?](#) ▶

**Printing reports**

Click Print Report to go to the report creation page. You can include information about each individual chemical as well as the reactivity predictions for all chemicals in MyChemicals.

[Print Report](#)



9. The officer has requested a printout of information about the chemicals as well as their predicted reactivity. To generate that printout, click **Print Report** (near the bottom of the Chemical Reactivity page).

10. You see a list of the chemicals that will be included in the report (thiourea and furfural), and a list of the information to be included in the report. Check or uncheck boxes to indicate the information you would like to include in the printout, then click **Preview Report**. The formatted report, including the sections you selected, appears in your browser window. Choose **Print** from your browser's menu to print the report.

**Substances to be included in the report**

1. [FURFURAL](#)
2. [THIOUREA](#)

Go to [MyChemicals](#) to edit this list.

**Choose the information to include in the report**

**Chemical Data Sheet**

- Section 1 - Chemical Identifiers
- Section 2 - Hazards
- Section 3 - Response Recommendations
- Section 4 - Physical Properties
- Section 5 - Regulatory Information
- Section 6 - Alternate Chemical Names

**Reactivity**

- Predicted reaction hazards for all the substances

Click Preview Report to view a printer-friendly report page. Then choose Print in your browser menu to print the report.

**Note:** You can print reports on chemicals from MyChemicals as well as from the Chemical Reactivity page. Reports can include any reactivity predictions you might have made. To print a report from MyChemicals for thiourea and furfural, you would click **View MyChemicals**, then **Print Report**. You then can format, preview, and print your report as shown above.

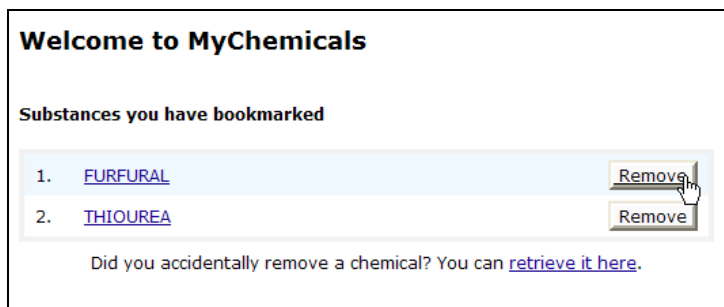
## Assessing a Dangerous Cargo Manifest

A chemical parcel tanker is scheduled to arrive at the Port of River City early tomorrow morning. (In this type of cargo vessel, the hold is divided into many tanks so that many different chemicals can be carried at the same time.) The officer in charge asks you to review the Dangerous Cargo Manifest (DCM) for this vessel, and report on the potential reactivity hazards from any hazardous chemicals on the tanker.

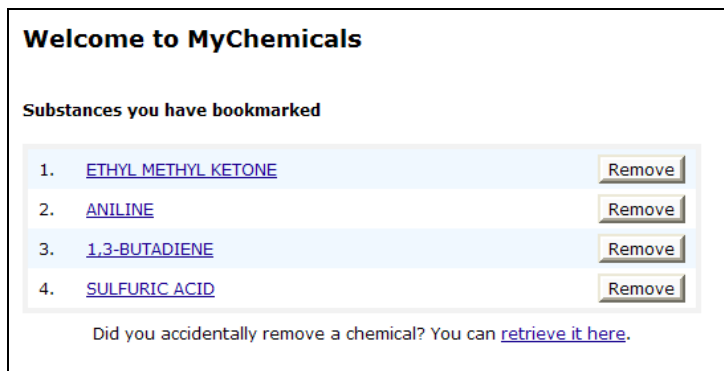
Reviewing the DCM, you find the following substances listed:

- Ethyl methyl ketone
- Aniline
- 1, 3-Butadiene
- Sulfuric acid

1. You need to empty out your MyChemicals workspace before beginning your assessment. Click **View MyChemicals** in the left navigation bar, then click **Remove** next to the name of each listed substance, until no chemicals are listed.



2. Click **New Search** in the left navigation bar. In the Name box, type "ethyl methyl ketone" and then click **Search**. This substance is the first chemical listed in the Search Results. Click **Add to My Chemicals** to add it to your MyChemicals list.
3. Search for each of the three other chemicals listed in the DCM. Add each to MyChemicals until your MyChemicals collection appears as shown below. Notice that searching for "butadiene" is the easiest way to find 1,3-butadiene.



4. In the left navigation bar, click **Predict Reactivity**. You see the following reactivity predictions, followed by a list of the potential reactions between each possible pair among the four chemicals:

**Hazard predictions if these chemicals mix**

- Reaction proceeds with explosive violence and/or forms explosive products.
- Heat generated from chemical reaction may initiate explosion.
- Spontaneously flammable in air.
- Spontaneous ignition of reactants or products due to reaction heat.
- Exothermic reaction. May generate heat and/or cause pressurization.
- Exothermic, potentially violent polymerization. May cause pressurization.
- Combination liberates gaseous products, at least one of which is toxic. May cause pressurization.
- Combination liberates nonflammable, nontoxic gas. May cause pressurization.

What you can't tell from this list alone is just which combinations of chemicals, if mixed, would cause the worst reactions.

5. But there is a quick way to see which pairings of chemicals would produce the worst potential reactivity hazards, using a compatibility chart. Scroll a little further down the page, and click **View as a chart**.

**Printing reports**

Click Print Report to go to the report creation page. You can include information about each individual chemical as well as the reactivity predictions for all chemicals in MyChemicals.

[Print Report](#)

**Hazard predictions for pairs of chemicals**

[View as a chart](#)

6. You see the following chart.

Notice that three of the chemical names are shortened to fit the table. The number next to each name in the table matches the number assigned to that chemical in the list of full names above the chart. For example, "1" next to "ETHYL MET..." indicates Ethyl methyl ketone.

**Compatibility chart**

1. ETHYL METHYL KETONE	1. ETHYL MET...			
2. ANILINE		2. ANILINE		
3. 1,3-BUTADIENE			3. 1,3-BUTAD...	
4. SULFURIC ACID	A6, B4, C, D3	A6, A9, B4, C, D3	A6, B3, C, D1, D4	4. SULFURIC ...

[How do I read this chart?](#) ▶

**Key to hazard codes**

A6 - Reaction proceeds with explosive violence and/or forms explosive products.  
A9 - Heat generated from chemical reaction may initiate explosion.

7. CAMEO Chemicals predicts reactivity between each of all the possible pairs of chemicals at a time, so you read the chart one pair of chemicals at a time:

The second row of the table shows reactivity predicted for the chemical **Aniline**. Read across to the second cell (box) in the row, then read up to the top of the column, where you'll find the shortened name for **Ethyl methyl ketone**. The second cell in the second row displays the predicted reactivity between Aniline and Ethyl methyl ketone. This cell is empty, meaning that no reaction is predicted if these two chemicals mix.

**Compatibility chart**

1. ETHYL METHYL KETONE	1. ETHYL MET...			
2. ANILINE		2. ANILINE		
3. 1,3-BUTADIENE			3. 1,3-BUTAD...	
4. SULFURIC ACID	A6, B4, C, D3	A6, A9, B4, C, D3	A6, B3, C, D1, D4	4. SULFURIC ...

[How do I read this chart?](#) ▶

No reaction is predicted between Aniline and Ethyl methyl ketone

Now look at the fourth row of the table, showing reactivity predicted for Sulfuric acid. Read across to the second cell in the row, which shows the predicted reactivity between Sulfuric acid and Ethyl methyl ketone. The four codes in this cell represent the predicted outcomes from mixing these two chemicals.

To find out what each code means, find it and its definition in the **Key to hazard codes**, just below the table. In the case of this pair of chemicals, mixing the chemicals could generate dangerous gases (D3) and potentially cause an explosion (A6); it also could generate enough heat to ignite the reacting chemicals (B4, C).

Codes in the next two cells of the row for Sulfuric acid indicate that this chemical would react dangerously with Aniline and 1, 3-Butadiene as well. Using the compatibility chart, it's easy to see that most of the potential mixing hazard from this chemical cargo would come from mixing sulfuric acid with any of the other chemicals. In a real response, you would want to consider ways to isolate this chemical.

**Compatibility chart**

1. ETHYL METHYL KETONE	1. ETHYL MET...			
2. ANILINE		2. ANILINE		
3. 1,3-BUTADIENE			3. 1,3-BUTAD...	
4. SULFURIC ACID	A6, B4, C, D3	A6, A9, B4, C, D3	A6, B3, C, D1, D4	4. SULFURIC ...

[How do I read this chart? ▶](#)

**Extensive reactivity is predicted between Sulfuric acid and Ethyl methyl ketone.**

**Key to hazard codes**

- A6 - Reaction proceeds with explosive violence and/or forms explosive products.
- A9 - Heat generated from chemical reaction may initiate explosion.
- B3 - Spontaneously flammable in air.
- B4 - Spontaneous ignition of reactants or products due to reaction heat.
- C - Exothermic reaction. May generate heat and/or cause pressurization.
- D1 - Exothermic, potentially violent polymerization. May cause pressurization.
- D3 - Combination liberates gaseous products, at least one of which is toxic. May cause pressurization.
- D4 - Combination liberates nonflammable, nontoxic gas. May cause pressurization.

Empty cells indicate no reaction is expected.

**Note:** To print this chart for the officer, you could either (1) use your browser controls to print the page, or (2) click **Export Chart** (at the bottom of the chart page) to save the chart to your hard drive as a CSV file that you could open, format, and print in a spreadsheet program such as Microsoft Excel®.

8. Since the chemicals are on a vessel and could spill into the water, their potential water reactivity is a concern. Next, you'll check the water reactivity of each of the four chemicals.

Click **View MyChemicals** in the left navigation bar, then click **ETHYL METHYL KETONE** to view that chemical's data sheet.


**Substances you have bookmarked**

1. <a href="#">ETHYL METHYL KETONE</a>	<a href="#">Remove</a>
2. <a href="#">ANILINE</a>	<a href="#">Remove</a>
3. <a href="#">1,3-BUTADIENE</a>	<a href="#">Remove</a>
4. <a href="#">SULFURIC ACID</a>	<a href="#">Remove</a>

Did you accidentally remove a chemical? You can [retrieve it here](#).

9. In the data sheet for Ethyl methyl ketone, check the NFPA 704 diamond to see whether a "W" indicating water reactivity appears in the white quadrant of the diamond. The white quadrant is empty, indicating that the chemical may not be strongly water-reactive.

CAS Number	UN/NA Number	STCC Number	CHRIS Code
78-93-3	1193	4909243	MEK

NFPA 704:  DOT Hazard Label: FLAMMABLE LIQUID

No water reactivity alert is shown


General Description

10. Next, check **Section 2 – Hazards**. Water reactivity information can be shown under two headings in this section: Reactivity Alerts and Air & Water Reactions. No alerts are shown in these locations, indicating that this chemical is not strongly water reactive.

**Section 2 - Hazards**

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**Reactivity Alerts**

 Highly Flammable

**Air & Water Reactions**

Highly flammable. Soluble in water.

No water reactivity alerts are shown.


11. Click **View MyChemicals** to return to the MyChemicals list, then open and review the data sheets for the other three chemicals.

Notice that only sulfuric acid is strongly water reactive. The NFPA 704 diamond for sulfuric acid includes a **W** indicating water reactivity:

**Section 1 - Chemical Identifiers**

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CAS Number	UN/NA Number	STCC Number	CHRIS Code
7664-93-9	1830	4930040	SFA

NFPA 704:  DOT Hazard Label: CORROSIVE

**Indicates water reactivity**


General Description


Other indicators of sulfuric acid's water reactivity are shown in Section 2 – Hazards. In the list of Reactivity Alerts, notice "**Water-Reactive.**" Under the Air & Water Reactions heading, notice that sulfuric acid reacts strongly with water, but only if it is very highly concentrated (sulfuric acid is a solution of sulfur trioxide in water; when there's less water in the solution relative to the sulfur trioxide, the solution is more concentrated):

**Section 2 - Hazards**

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**Reactivity Alerts**

 Strong Oxidizing Agent

 Water-Reactive

**Indicators of water reactivity**

**Air & Water Reactions**

Reaction with water is negligible unless acid strength is above 80-90% then heat from hydrolysis is extreme, may cause severe burns [Merck, 11th ed. 1989]. During sulfonation of mononitrobenzene by fuming sulfuric acid, a leak from an internal cooling coil permitted water to enter the reaction tank. A violent eruption occurred due to the heat of solution [MCA Case History 944 1963].





12. There are other kinds of reactivity that the officer should be informed of: for example, 1,3-butadiene is air reactive. Reopen this chemical's data sheet and go to **Section 2 – Hazards**. You'll see that information in three places (shown circled in red below). When exposed to air for a long period of time, 1,3-butadiene forms peroxides, an especially unstable category of chemical that can be dangerously flammable and explosive. A chemical that forms peroxides is called *peroxidizable*.

Besides being air-reactive and peroxidizable, 1,3-butadiene also is highly flammable and polymerizable.

**Section 2 - Hazards**

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**Reactivity Alerts**

-  Highly Flammable
-  Polymerizable
-  Air-Reactive
-  Peroxidizable Compound

**Air & Water Reactions**

Highly flammable. In contact with air, butadiene may form violently explosive peroxides, which can be exploded by mild heat or shock. Solid butadiene absorbs enough oxygen at sub atmospheric pressures to make it explode violently when heated just above its melting point [Ind. Eng. Chem. 51:733 1959].

**Fire Hazard**

Behavior in Fire: Vapors heavier than air and may travel a considerable distance to a source of ignition and flashback. Containers may explode in a fire due to polymerization. (USCG, 1999)

**Health Hazard**

Slight anesthetic effect at high concentrations; causes "frostbite" from skin contact; slight irritation to eyes and nose at high concentrations. (USCG, 1999)

**Reactivity Profile**

A colorless gas, it can react with oxidizing reagents. Upon long exposure to air it forms explosive peroxides. They are sensitive to heat or shock; sudden polymerization may occur [Scott, D. A., Chem. Eng. News, 1940, 18, p.404]. Butadiene polyperoxides are insoluble in liquefied butadiene (m. p. -113° C, b. p. -2.6° C) and progressively separate leading to local concentration build up. Self-heating from a spontaneous decomposition will lead to explosion [Hendry, D. G. et al., Ind. Eng. Chem., 1968, 7, p. 136, 1145]. Explodes on contact with aluminum tetrahydroborate, potentially explosive reaction with chlorine dioxide (peroxide) and crotonaldehyde (above 180° C). Reaction with sodium nitrite forms a spontaneously flammable product [Sax, 9th ed., 1996, p. 539]. (REACTIVITY, 2003)

As a final step in your assessment, you could create a printout for the officer: to do that, you would click **Predict Reactivity** in the left navigation bar, then click **Print Report**, format your report by checking or unchecking boxes, then click **Preview Report**, then select **Print** from your browser's menu.

You've just completed an initial guided tour of CAMEO Chemicals by using the website for a series of hypothetical incident responses. You now should be able to:

- Find chemicals, and review and print their data sheets.
- Add chemicals to a MyChemicals collection.
- Predict potential reactivity between chemicals, display a compatibility chart, and print your reactivity findings.
- Find out about the potential air- and water-reactivity of chemicals.

With these skills, you're ready to use CAMEO Chemicals for your real-life response and planning work. Congratulations!