Process Safety: A Review on Understanding a Safety Data Sheet (SDS)

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Abstract:

SafetyDataSheets(SDS),formerlyknownasMaterialSafetyDataSheets(MSDS)intheUnitedStates,containsimportantinformationforthesafehandlingofchemicals.Thisarticlediscussestheuseofsafetydatasheetsinprocessdesignandsafechemicalhandling.ThethreemaincategorieslistedontheSDS(flammability,physical,andtoxicity)areexplained.Withineachcategory,examplesareprovidedforusingspecificinformationtodesignsafechemicalprocesses.Inaddition,intheUnitedStates,theOccupationalSafetyandHealthAdministration(OSHA)reviseditshazardcommunicationstandardsinMarch2012.Infact,thisstandardhasbeenintegratedintotheUN'sGloballyHarmonizedSystemofClassificationandLabelingofChemicals(GHS).Thechangesincluderequirementstousestandardsignalwords,pictures,hazardstatements,andwarningstatements.

Keywords - climate resilience, environmental challenges, economic capacities, sustainability

1.0 INTRODUCTION :

Theuseofchemicalproductstoenhanceandimprovelifeisacommonpracticethroughouttheworld.However,inadditiontothebenefitsoftheseproducts,theremaybenegativeeffectsonpeopleortheenvironment.Therefore,manycountriesandorganizationshavepassedlawsorregulationsovertheyearsthatrequireuniforminformationandprovideinformationtochemicalusersthroughlabelingandsafetydatasheets(SDS).).Giventhelargenumberofchemicalproductsavailable,nosingleentitycanhandleitalone.Providinginformationallowschemicaluserstounderstandthenatureandhazardsofthechemicalandtoprovideappropriateprotectivemeasurestobeimplementedinthelocaluseenvironment

Giventhewidespreadnatureoftheglobalchemicaltradeandtheneedfornationalinitiativestoensurethesafeuse,transportanddisposalofchemicals,itwasrecognizedthataglobalapproachtoclassificationandlabelingwasthebasisforsuchaninitiative. Whencountrieshavethesameinformationaboutthechemicalstheyimportorproducelocally,theycancreatestructurestomanagechemicalexposureandprotectpeopleandtheenvironment.

2. EXAMPLE: A SAFETY DATA SHEET FOR HEXANE

Recently,Iaskedsomefriendsandgraduatestudentstoprovidemewithasafetydatasheetforthechemicalhexaneinmynativelanguage.Interestingly,someofthelabelsonthesafetydatasheetsareverysimilararoundtheworld.OpentheinformationonthesafetydatasheetinAmericanEnglish,Mandarin,Korean,andFarsi.TheultimategoaloftheGHSistoachieveglobalharmonizationofthesetablesinalllanguages.Theattachedexamplehas16keysections.UndertheGHS,allsafetydatasheetsinalllanguages oftheworldwilleventuallybethesamein16mainsections. Althoughallsectionscontainimportantinformation,thisarticlefocusesonthesectionsthreeareusefulforriskanalysis. Thesesectionsare:Section5,FireFightingOperations;Section9,PhysicalandChemicalProperties;andSection11,ToxicologicalInformation

3.0 EXAMPLESOFUSESOFSAFETYDATASHEETSINDESIGNANDPRACTICE

BelowaresomeofthekeystepsItookintheinitialhazardanalysisrelatedtothesolventreleaseroomrequirementsanddesign.

3.1 THE MISSION

Mission:Abilitytoextractandstoren-hexaneinasafemanner.Whenneeded,hexanecanbesafely distributedtootherareasofthehouseatarateof4literspermi nute(upto30minutes).

3.2 SECTION 2 : HAZARD IDENTIFICATION

AreferencetotheSafetyDataSheetshowninSection2ofthe Appendiximmediatelyinforms aboutdanger.Highlyflammableliquidandflammablevap ors.Thefogcauseslightning.Maycauserespiratory,eyean dskinirritation.Organdamagemayoccurinanimals.

3.3SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Section9providesimportantinformationthatsafetyengin eerscanuseintheirhazardanalysis.Inthiscase,themolecul arweight(86.2g/mol)isgivenandthemolecularformulais given.Theboilingpointis68.9℃,thefreezingpointis-139.4℃.Allofthesehelptounderstandthedangersofhandl inghexane.Forexample,thereislittleconcernthathexane willfreezeatroomtemperature.Hexanehasaboilingpoint of68.9°C.Thisisaproblem.Movementinthepipemustbefr eefromfrictionandheatsourcestopreventtheliquidfromh eatingbeyonditsboilingpoint.Ifthepressurevalueofthepi peistoolowtocarryhexane,thetemperaturewillexceed68. 9°C,andthepipewillburstduetohighpressureduetoevapor ation.Therefore,apressurereliefsystemmustbeaddedtoth estoragetankanddeliveryline.

Addingaproperpressurereliefsystemcanreducetheriskof an explosion. Anotherparameterthatisimportantforriskanalysisinthisa reaisthespecificgravityofhexanewaterrelativetowater.H exanehasawaterspecificgravityof0.66.Also,hexanecann otmixwithwater.Ifthereisaleak,theliquidhexanewillreac hitslowestpoint,andifthefloordrainoftheroomentersthatl owpoint,thehexanewillflowintothehousewatertank.Sin cehexaneislighterthanwater,itdissolvesinlayersofwater. Thisintroducedflammablehexaneintothebuilding'swate rsupply,causingapowerfulexplosionthatdestroyedthebu ilding.Therefore,thechamberdesignshouldincludeaseco ndholdingtankbelowthehexane-containingpartoftheprocess. Vapordensityparameter3.0relativetoair.Hexaneisthreeti mesdenserthanair.Thisnumberisveryhelpfulinunderstan dingnegativesituations.Ifthehexaneescapesintothesurro undingarea,itsinksfirst.Itisheavierthanair.Thismeanstha ttheproperplaceforasmokedetectorisatthebottomofthero om,notatthetop.Ofcourse,it'sinthespecificpartsoftheLF LthatSection5covers.

Anotheruseofvapordensityistoestimatetheamountofwat erthat,ifspilled,wouldformaflammablemixture.Startwit haroomthatis6meterslong,6meterswide,and3metershig h(108cubicmeters).Theflammablelimitofhexaneis1.7% .If108cubicmetersx1.7%,or1.8cubicmeters,ofhexaneva porenterstheroom,theroomislikelytobeflammable.How muchhexaneisthis?Atatemperatureof20°C,thedensityof airis1.2kg/cubicmeter.Multiplyingthisvaluebythreegiv esadensityofhexanevaporof3.6kg/m3.Thus,if3.6kg/m3t imes1.8m3or6.5kgofhexaneentersaroom,afireorexplosi onmayoccur.Usingthespecificgravityofwater(0.66),this amountisequivalentto10litersofhexanespilled.

3.4SECTION11: TOXICOLOGICAL INFORMATION

Section11presentstoxicologicalinformationforthechemi cal.Twomainparametersareprovided.TheseareLD50and LC50forspecieswhicharetypicallyrats.LD50provideesti mationsastothedoseifhexaneisingestedthatwouldkill50 %ofthepopulationatthedoserateprovided.Forexample,h exanehasaLD50of25g/kgforrats(dosepermass).If100mi ce,and0.25kg(1/4kg),eachmouseingests7.5ghexane(1/4 oftheLD50perkg)atonetime,50micewilldieintheafewda ys.Also,exposuretohexanevaporisalsoperformed.Inthis case,theparameteriscalledLC50(lethalconcentrationthat kills50%ofthepopulation).If100micebreatheaircontaini ng96,000ppm(or9.6%hexane)foronehour,50micewilldi e.ThelastparameterinthiscategoryisIDLH,RisktoLifeor Health.Itis1,100partspermillion.Thisparameterisapprop riateforworkerswhomaybeinenvironmentscontainingthe xanevapors.Iftheconcentrationofthisenvironmentexcee ds1,100ppm,theseworkersrisktheirlivesorhealth.Inthisc ase,theproblemsarerelatedtofireandexplosion.1,100pp mcorrespondstotheflammablelimitandisabout1/10ofthe flammablelimitof1.7%.

Fig 1Auniversaltransportationplacardtobeplacedontrucksanddrumscontainingflammableliquidssuchashexane(signbackgroundcolorisred)

4.0POLICY AND REGULATORY FRAMEWORKS

Policy and regulatory frameworks play a crucial role in climate change resilience strategies. These frameworks are designed to guide both mitigation efforts, aimed at reducing the causes of climate change, and adaptation strategies, which prepare communities for the effects of a changing climate(“The Forest Policy Process, Regulatory, and Institutional Frameworks in Ethiopia”). They encompass a range of measures, including setting emissions reduction targets, enforcing environmental regulations, and promoting sustainable development practices. Importantly, these policies also focus on funding and investment in green technologies and infrastructure that can withstand climate impacts. Additionally, they often include provisions for research and development, aimed at advancing our understanding of climate change and developing innovative solutions(Waiti and Lorrenij). Education and public awareness campaigns are also key components, helping to cultivate a societal shift towards more sustainable practices. Collaboration across different sectors and levels of government is essential for the effective implementation of these policies, ensuring a coordinated and comprehensive response to the challenges posed by climate change. This multifaceted approach, underpinned by strong policy and regulatory frameworks, is essential to building resilient communities and safeguarding our environment for future generations(Waiti and Lorrenij).

Fig.2GHSpictogramsymbolsfor n-hexane.Seetextaboveforthe meaningofeachone.

5. CONCLUSION

ThisdocumentprovidesanexampleofusingaSafetyDataSheet(SDS)foraninitialhazardanalysisofchemicaluseandstorage,whichcontainsthreemainsections:flammability,physicalproperties,andtoxicology.

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