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# DesignandFabricationofBottle Crushing Machine Using PLC & SCAD

**A.Ferminus Raj[**], Ajay babu[*], S.Kandasaamy* ,D.Beatrick king Joushua*, Krishnan.M***

**Assistant Professor SCAD College of Engineering and Technology, Tirunelveli, India

UG Scholar, SCAD College of Engineering and Technology, Tirunelveli, India

**Abstract**:AbottlecrusherisadeviceusedforcrushingPlastic Bottleforeasierstorageinrecyclingbins.Whilemostrecyclersdo n'trequireyoutocrushbottle,ifyoudorecyclealot,yournormalbi nmayfillupquickly.Thecrushergivesyouextraspacebyflattenin geithersingleormultiplebottle.Thisprojectisaboutdesigningan dfabricatingtheRecycleplastic bottleCrushertohelppeopletocrushthebottlesandaideasiertrans portation.Thisprojectinvolvestheprocessofdesigningthecrush erconsideringforcesandergonomicfactorsforeasierhandling.A fterthedesignwascomplete,itwastransformedtoitsrealproduct wherethedesignisusedforguideline. Theseprojectsalsorequireensuringthehumansafety.Methodsa ndprocessinvolveinthisprojectarejoiningusingbending,weldi ng,drilling,andcuttingprocess.Thisprojectismainlyaboutgener atinganewconceptofplastic bottlecrusherthatwouldmake easier to bring anywhere and easier to crush with the bottle.

KEYWORDS: DCV, FCV Compreser bottles, Double acting Cylinder, Hopper, Electric motor ICS.

## I. INTRODUCTIONS

This project consists of designing and fabrication of an automatic crusher machine. A b crusher can be defined as a device used for crushing aluminum cans or plastic bottle for easier storage in recycling bins thereby giving you extra space by crushing of cans. The main aim of the project is to reduce the scrap. In order to reduce the waste, we planned to create a bottle crushing machine that will reduce the volume of plastic bottle by approximate 75 percent by which transportation volume will increase and transportation cost will reduce. We can crush Cold drinks bottle and other beverage bottle by using this machine. Commercial establishments like cafeteria and bars, have to deal with leftover cans. Storage is often a problem and bottle consume lot of space, thereby increasing total volume of trash. The transportation cost is also high for moving such a huge number of cans. This machine will help to recycle and maintain eco- iendly environment also. In this design it uses 5/2DCV's,FCV,Twosingleactingcylindersoneforpushinga ndotherforcrushing,aframe,hoses&connectors.PLC,relay &ultrasonicsensor.Itsframeisofverticaltypewhichcanbepla cedonwall.In2004,60billionaluminumcanswerelandfilled, litteredorincinerated,that's10billionmorethanwerewastedi n2002.ThisisenoughcanstofilltheEmpireStateBuildingtwe ntytimes.Itisalsoaquantityequivalenttotheannualproductio nofthreetofourmajorprimaryaluminumsmelters.Theenerg yrequiredtoreplacejustthesewastedin2001wasequivalentto 16millionbarrelsofcrudeoil,enoughtomeettheelectricityne edsofallhomesinChicago,Dallas,Detroit,SanFranciscoand Seattleetc.Duringthetimeittakesyoutoreadthissentence,50, 000more12-ounce plastic bottlearemade.Americansthrowaway25,000,000aluminu mbeveragecanseveryhour.Thusthiscrushermachinewillhel ptorecyclethemandmaintainaneco-friendlyenvironment.

## II. LiteratureSurvey

Westudiedthatbottlerecyclingisveryimportantparto fanyfamilyandcommunityrecyclingprogram.Plasticrecycli ngisoneoftheeasiestthingsyoucandotohelptheenvironment. Recyclingofbottlebeganalongagoandstartedtobecomecom moninearly1970"s.bottleis100%renewable.Thismeansthat wecanrecycleanewbottlefromusedbottle.Justwehavetocrus htheusedbottleandwehavetotransportthemtothefactory.Bec auseofcrushingofbottleitstransportationcostwillreduceandl essspaceisrequiredtostorethem.Youmightbesurprisedtokno wthatwithin60daysanplastic bottleisabletogofromyourrecyclingcenterandbecomesabran dnewbottletobeusedbyconsumer.

- **Machine**

Acrusherisamachinedesignedtoreducelargesolidma terialobjectintoasmallervolumeor pieces.Crusherreducesthesizeorchangetheformofwastemater ialsotheycanmoreeasilydisposedorrecycles

### 2.2. Pneumatic system

Pneumatics is a section of technology that deals with the

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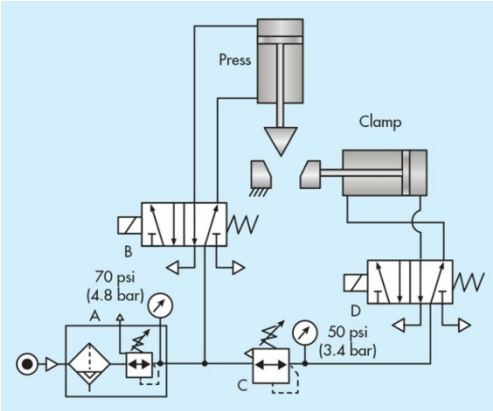
study and application of pressurized gas to produce mechanical motion. Pneumatic system, which are used extensively in industry and factories are commonly plumed with compressed air or compressed inert gases.

**3.PneumaticCircuit**




**4.Design&Calculation**

Themainaimofthisistostudythe completedesignofAutomaticbottlecrushermachine.Wehav etodesignpushingandcrushingcylinder.

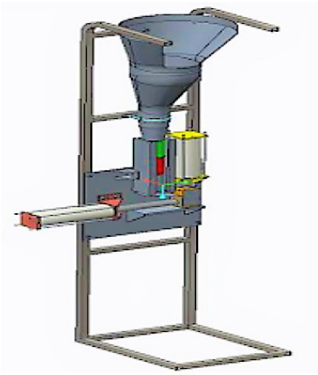


**Figure 4.1 Modeling of machine**

**4.1Cylinder**

Thematerialusedforthecylinderisaluminum;ith oldsapistonandgivesdirectiontoapiston.Underverticalcyl inderbottleiscrushed.InhorizontalCylinderActuatoristhe reitisusedtopushthebottleforcrushing.

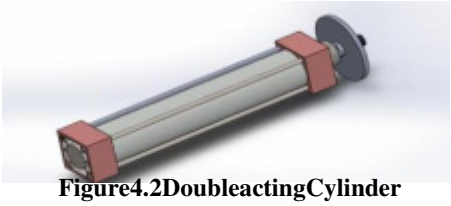


**Figure4.2DoubleactingCylinder**

**i.Forcegeneratedbycrushingcylinder**

1.Diameterofthecylinder-37.5mm
2.Diameterofthepistonrod-10mm
3.Operatingpressurerange-1-9bar
4.Endurancepressure-10barF=PXa

$A=3.14/4xD^2$

$A=3.14/4x37.5^2$

$A=1105mm^2=1.105x10^{-3}m^2P=F/A$

$6.5x10^5=F/(1.104x10^{-3)}F=717.90N$

Forceduringretractingstroke:-P=F/(A-

$a)1x10^5=F/(1.104x10^{-3}–7.853x10^{-5})$

F=102.54N

**ii.Forcesactingonpushingcylinder**

1.Diameterofthecylinder-15mm
2.Diameterofthepistonrod-7mm
3.Operatingpressurerange-1-9bar
4.Endurancepressure-10bar

Forceduringextendingstroke:-

$F=PxAA=3.14/4xD^2A=3.14/4x15^2$

$A=176.625mm^2=1.761x10^{-4}m^26.5x10^5=F/(1.761x10^{-4)}$

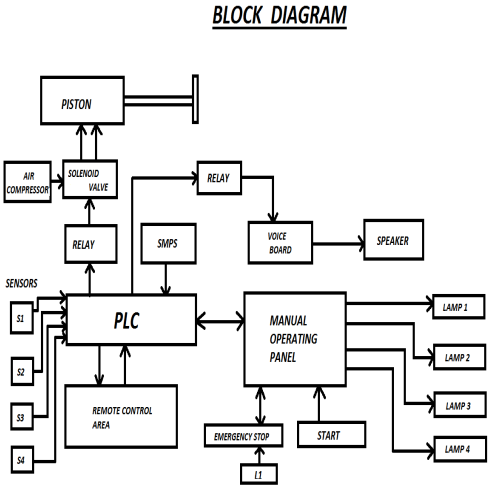
F=114.465N

Forceduringretractingstroke:-P=F/(A-

$a)1x10^5=F/(1.7671x10^{-4}–3.848x10^{-5})$

F = 13.82 N

**Block Diagram**



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When the shutter is opened relay 2 activates the voice board. After insert the bottle in the hopper,the sensor 1 get activated and gives the singal to the PLC.After the shutter closed the leaf switch get activated .when the start button is pressed the PLC check the sensor state when the sensor 1 state is high the PLC will gives the 24v output signal to relay 1 to activate the solenoid value to move the piston cylinder forward to crush the petbottles after few seconds the output signal changes its state to low and the piston move backwards.

After that crushed pet bottle falls in to the container and the sensor 2 activated to counter the no. number of bottles collected in the container and the lamp 3 blinks .sensor 3 is act as the low sensor of the container. Sensor 4 is activated when the container is full . if the sensor 4 activated the whole system will stop . Emergency switch is provided to stop the process during emergency sitiuation and the Emergency lamp will glow.

**4.2Bottle Holder**

**Figure4.3Bottleholder**

i. tsNameitselfsuggestthatisholdsabottle.
ii. Abottleholdercanhold3bottlecomingfromHopper.
iii tisGenerallyMadeofsteelMaterial. ItscrosssectionisofC–shape.
iv.

**4.3Hopper**

Figure 4.4 Hopper

Ahopperinbottlecrusherisusedforcollectingallthe bottlethrownatthetop.Inthisdesignwehavemadehopperwith fiveparts.Itissodesignedthatifthebottleisthrownatthetopofh opperitwillfallverticallydownwardandthebottlewillbecollected atthebottominastraightpostion.Thebottlewillalsonotgetstuckatthemidwayofthehopperifwotothreebottlearethrownsimultaneously

**4.4PLC**

.

**Figure4.5 Programmin logic controller**

Itisusedtocontroloverallsystem.Aprogramisinstalledinit.It isintelligencepartofthissystem.

**4.5Sensor**

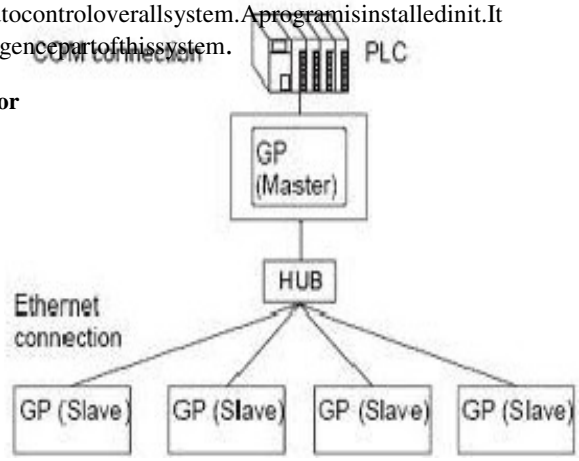


**Figure 4.6 Ultra sonic sensor**

**Electric Parameters:**

| | |
|---|---|
| WorkingVoltageDC | 24V |
| WorkingCurrent | 15mA |
| WorkingFrequency | NIL |
| Range | 2cmto400cm |
| Object sensor | 10uSTTLpulse |

**SYSTEM CONTROL USING PLC & SCADA**

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PLC is used for centralized management. It is a Master PLC. Many Slave PLCs are connected to Master PLC. SCADA is used for outer loop management. In each power unit there exists a slave PLC, which is connected to the master PLC through a Profibus network. This power unit PLC monitorsand controls the on-line powerdelivery to the electric grid. Similarly each ESS has a slave PLC controlling the income/outcome energy in the system. Each PLC hosts several control programs whose selection is made either locally, via an HMI (Human Machine Interface) or remotely, via the Master PLC. The Master PLC is connected to the server PC, via RS232/ MPI Siemens protocol, where the SCADA application is running.

The server PC is simultaneous a SCADA server and an internet server, as the implemented SCADA application is web enabled. All process variables are available at the SCADA PC as these variables are on-line available through a Profibus/ DP connection protocol (Siemens,2001a).

The four slave PLCs for windfarm, PV, Hydro & Biomass respectively. A Supervisory Control and Data Acquisition (SCADA) System is used as an application development tool that enables system integrators to create sophisticated supervisory and control applications for a variety of technological domains, mainly in the industry field. The main feature of a SCADA system is its ability to communicate with control equipment in the field, through the PLC network. As the equipment is monitored and data is recorded, a SCADA application responds according to system logic requirements or operator requests. In the developed control strategy, the SCADA application performs the outer control loop of the energy plant system. At this outer loop several complex control structures can be used to manage the overall system dynamics.

Assuming that the projected hybrid power plant had been optimal designed (Shaahid&Elhadidy, 2008), the role of the platform here developed is basically to minimize the energy supplied by the oil-based back-up power units. We use the potential of the SCADA supervisory platform to integrate the monitoring of the real production figures on the optimization problem.

The proper electricity production to each power unit is presented below in below eqn [15].

$$\min J = \sum CPVi\,YPVi + \sum Cwindj + \sum CoilWoil$$

where: cPVi = production cost associated with PV plant i; yPVi = requested Watt-power to be supplied by PV plant i; cwindi = production cost associated with Wind plant i;
coil = production cost associated with oil-based thermal plant i; The optimization algorithm implemented for the energy management, at the SCADA outer loop control, could not be implemented directly on the SCADA system, as this complex controller needs mathematical operations that are not present at usual available SCADA systems. In this paper we developed a strategy to couple the SCADA system with the MATLAB software (Mathworks, 2005). [13] The communication between SCADA and MATLAB was performed using the DDE protocol (Dynamic Data Exchange). This communication protocol, developed in the 90's but still very common, permits the exchange of data between two independent running software programs (Client and Server).

**6.Software & Hard ware Requirements**

The software nused for the PLC programming was the Delta .The SCADA system was developed over the platform Wonderware(INTOUCH)

**6.1 PLC Properties:**

- PLC Company : Delta
- PLCProgramming Language: Ladder
- PLC Model : DVP 14SS
- Power supply : 24V
- I/P Rating :7
- O/P Rating : 5
- Max I/O's :230
- Protocol: RS 232

**6.2 SCADA Properties:**

- SCADA Company: INTOUCH
- SCADA Prog.Language: Assembly Language
- SCADA S/W: IN Touch9.5V
- SCADA/PLC Interfacing server: : kepserver
- No.of Tags : 1600
- Relay O/P: 24 V [DC]

**6.3 Push Buttons:**

- (I/P)= 1

**6.4 Lamps:**

- 24V DC= 5

**6.5 Hardware Cost Analysis:**

- Delta PLC : 6000
- Air compreser : 6500
- Solinoid Valve : 1635
- Pneumatic piston : 1500
- Push Button : 50
- Connecting Wire : 200
- Ply wood : 1000
- Voice board : 800

**7.Result And Discussion**

The SCADA system used to implement this monitoring and control strategy permits the selective access to the application,depending on the user responsibility degree.in this paper we developed Bottle Crusing Machine for reduse

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the plastic waste.we (human) are responsible to make the plastic less world.

## 8. Acknowledgements

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We are also grateful to Ferminus Raj, HeadDepartment of Electrical Engineering for providing moral support and guidance. Our sincere thanks are also due to all the faculties of Electrical Engineering Department for suggestions and motivation

## 9.CONCLUSION

Usingthisprojectweplastic bottledisposemorenumberofbottleinlessspace.Alsoenergyrequiredforrecyclingthecrushedbottlewillbelessascomparedtocanswhicharenotcrushed.Thetransportationcost forthiswillalsobeless.

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