iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6246

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Experimental Investigation of Blank Temperature and Blank Holding Pressure on the Punch Force and Limiting Drawing Ratio- A Review

Ashwin Jaiswal[1], Prof M. J. Deshmukh[2]
[1]M-Tech Student (Production Engg.) Department of Mechanical Engineering, GCOE Amravati, Maharashtra, India
[2] Professor, Department of Mechanical Engineering, GCOE Amravati, Maharashtra, India

Abstract: Deep drawing has been used for the purpose of production since a very long period of time. This conventional drawing process possesses various limitations in production. To overcome this, one of the prime technological advancement for this process is warm deep drawing. A better flow ability in warm deep drawing helps to overcome the limitations in the conventional drawing process. This paper provides a brief information of the current trends in the warm deep drawing process. Findings and parametric study of various researchers have been stated. Thus it gives an area where future study can be done.
Keywords: Deep drawing, Warm deep drawing, Better flow ability

I. INTRODUCTION

According to DIN-German standard deep drawing is defined as a tensile or compressive sheet metal forming process in which a bland of metal is converted into a hollow part open from one side (direct drawing) or a hollow part is converted into another hollow part of comparatively smaller cross section (re drawing). Deep drawing is one of the easiest and cheapest way of forming hollow components. Hence deep drawing is used in most of the industries for the production purpose. This process is widely applicable for the manufacturing of parts for aircraft and automobile industries. The fig. shows a general deep drawing process. In deep drawing process a die is designed of required shape and size depending on the product to be made. The punch of required capacity is utilized. A blank holder applying appropriate pressure is used. In deep drawing process a die is designed of required shape and size depending on the product to be made. The punch of required capacity is utilized. A blank holder applying appropriate pressure is used. First of all as shone in fig.:-1 (a) blank of which product is to be made is placed over the die. The size and thickness to the blank is selected by drawing ratio for the material. Then the punch and knockout meets at the interface as shone in fig.:- 1(b). Then in the next step the punch punches the blank into the die as shone in the fig.:-1 (c). As the punch moves forward the required product is formed in the die. Thus the product is completely formed and is removed from the die as shone in the fig.:- (d).

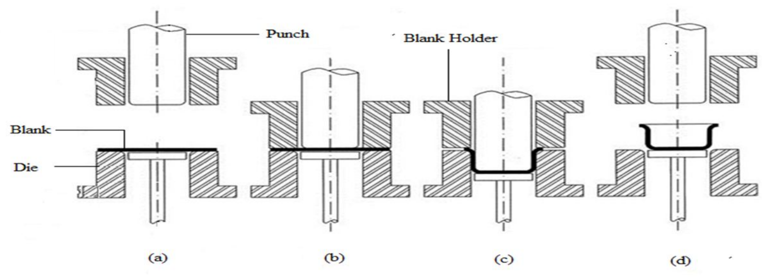


Fig. 1 Deep Drawing Process

The conventional drawing processes had its own disadvantages or limitations in the industrial applications. Thus it was important to have some technological upgradation to overcome those limitations. The limiting drawing ratio for a certain material is fixed for cold working. Also the force required to draw in cold working was more. Hence to overcome such limitations Warm deep drawing process was developed. Warm deep drawing is a non-conventional deep drawing process which is performed by applying heat in the conventional deep drawing process, at the same time the blank is kept bellow the recrystallization temperature. This is can be achieved by three main methods heating the blank, heating the die or heating the punch. A simultaneous combination of them can also be equipped for better results. The main aim of any non-conventional processes is to improve the forming characteristics of the material so as to produce the components which are free from any defects such as fracture, wrinkles and tearing. The elevated temperature decreases the flow stresses and increases the formability of the material enabling easy deformation.

©IJRASET: All Rights are Reserved

II. OBJECTIVES OF STUDY

A. To reduce punch pressure.
B. To increase limiting drawing ratio.
C. To reduce the blank holding pressure
D. To form defect free products.

III. REVIEW ON WARM DEEP DRAWING

Rashmi Dwivedia, Geeta Agnihotrib , in this paper the studied the different process parameters of the deep drawing processes. They thus evaluated the critical parameters that will affect the deep drawing process. The author studied the effects on the drawing process and on the product when this critical parameters are varied. He suggested that the process parameter such as blank holding pressure is an important parameter as wrong blank holding pressure could lead to defective products. Friction is also an important factor as thickness distribution and surface quality depends on it. [1]

Adnan I. O. Zaid, in this paper demonstrated the mechanism of how the material is deformed in the deep drawing process. Also it show the different forces acting during drawing. The experiment was performed using die manufactured of galvanized steel for this purpose. The blank used was 180mm diameter, 0.42mm thickness carbon steel. Effect of blank Holding pressure and drawing ratio on the punch load was studied. Author also provided the defects that may be encountered in drawing process. The paper concludes that the maximum drawing force is greatly influenced by the radial clearance between the punch and the die. The maximum drawing force decreases with increase of the die profile radius. The maximum drawing force increases with increase of the punch profile radius. [2]

M.A.M. Basril, H.M. Teng, I.A. Choudhury, performed this study to investigate the effect of heating temp and most effective heating position to perform warm deep drawing operation without failure. Different sizes of square blanks were deep drawn at room temp, 100°C, 150°C, 200°C using three different heating techniques- heating die only, heating punch only and heating both die and punch. The experimental investigation showed that the thickness distribution in certain heating condition, and thickness is more uniformly distributed within round square cup and the minimum thickness at the punch corners reduced when compared to deep drawing at room temp. ANOVA result shows that blank size has greatest effect (37.2%) on thickness followed by heating technique (32.5%) and heating temperature (0.15). [3]

N. Ethiraj, V.S. Senthilkumar, in this paper investigated a 1.0mm thick circular specimen of stainless steel AISI 304 which was warm deep dawn. The influence of temperature on the behaviour of material and drawing loads which are required to draw the component was studied. The heating was done with the help of thermocouple and temp was controlled by temperature controller. This had positive effects on reducing drawing loads and very little change in thinning and thickening, as compared to conventional technique. [4]

N. Ethiraj, P. Ganesh, V.S. Senthil Kumar, in this paper carried out the study to evaluate the thickness distribution of the warm deep drawn circular cup from AISI 304 stainless steel sheet of 1.0 mm thickness analytically at temperatures ranging from room temperature to 300°C. It is observed that the maximum thinning occurs in the punch corner radius region as that of the experimental observation. This may be attributed to the fact that this region is subjected to bending twice: one over the punch and the other on the die radius. The results proposed that the thickness distribution variation is low (15.32%). [5]

Nuri Sen, Ibrahim Karaagac, Naci Kurgan, in this paper performed experimental research on the formability of HC420LA grade sheet material using the warm deep drawing (WDD) method. In this method, a new temperature control system was designed and manufactured to increase the formability of HC420LA grade sheet material. Certain lubricants were used to reduce the temperature rise due to friction. A new cooling system was designed to cool the punch contact zone of the blank. This improved the limiting drawing ratio of HC420LA grade sheet material. The thickness reduction was low (15%). Microstructural study showed legible change in microstructure and mechanical properties. [6]

Sumedh Kulkarni, Syed Nadeem Akhtar, in this paper experimentally verify the warm deep drawing process assisted with hydraulic counter pressure as a suitable alternative to conventional deep drawing as a means for producing defect-free sheet metal parts. To carry out experiment single acting press is converted into double acting. The die block is designed to be lifted against a fixed blank holder. The sheet metal is deep drawing steel (ASTM A591). The adopted process improves the formability of the sheet material. There is an increase in LDR as a result of thermal softening and uniform distribution of the resisting hydraulic force on the sheet throughout the drawing process. Thickness variation that has been studied on the drawn product has been consistent in the warm deep drawing process. [7]

N. Ethiraj, V. S. Senthil Kumar, in this paper investigated on stainless steel AISI 304 grade blanks of 1.0 mm thickness with different diameters which were drawn into a circular cups in single stage. The experiments were carried out at room temperature as

©IJRASET: All Rights are Reserved

well as at temperatures 100°C, 200°C, and 300°C respectively. The experiment were carried on a setup in which the punch and the die is made up of tool steel and the blank holder is of mild steel. Heating was provided by K type thermocouple. 60 Tonnes hydraulic press was used which has a stroke length of 400mm and a daylight of 600mm for the experimentation. They found that the formability of the material was increased. There was a 23.8% increment in limiting drawing ratio. [8]

MGhosh, A Miroux, R. J. Werkhoven, P. J. Bolt, L. A. I. Kesten, in this paper investigated two Al-Mg-Si alloys for deep drawing process agonised room temperature and 250°C. Then their behaviour was compared. Reverse deep drawing process was employed. Hasting rods were used for the purpose of heating at the die and blank holder. The punch was cooled by internal water-cooling system and thermocouples were used for sensing temperatures at punch, die and blank holder. Ram speed, dearing ratio, holding time and temperature were the test parameters. Among those temperature was concluded the critical perimeter. The amplitude or earing defect in the drawn product were reduced with increasing temperature. [9]

Erdem Kayhan, Bilgin Kaftanoglu, in this paper conducted warm deep drawing process on DP600, IF, and HSLA steels. The flange region of blank is heated up to temperatures in the warm range by inductance heating. The inductance coils were wrapped around the die for heating. During heating, the central portion of blank is cooled by water in order to prevent the reduction of the strength of the product in the central region. Two infrared sensors were used for temp sensing. They found that increases up to 25.58% on LDR are obtained. There is no significant change in the microstructure of the material due to warm forming. [10]

Vedant Savasa, Omer Secgin, in this paper performed experimental analysis of a new type of deep drawing and the factor affected through it. The blank holder and die were given a certain angle (α). The effects due to this were studied. An increase is limiting deep drawing ratio (β) from 1.75 to 2.175 was noticed as the value of α increased from 0. This design also have effect on the blank holding force as it decreases as the value of α is increased. Blank holding force has decreased to 3002N from 10362N. Energy required and the cost of die can be decreased with this die type. [11]

M. Gavs, in this paper studied experimentally the possibilities of increasing this limitation using the multi-point blank holder. Al-1050 aluminium sheet with a thickness of 1.0 mm is used for the blank material. Multi-point blank holder (Mpbh), basically, consists of normal blank holder under which balls have been placed most closely packed between inner and outer spacer rings. For the deep drawing of Al-1050, LDR was increased from 2.33 to 2.39 by the multi-point blank holder. The height of the cup drawn from multi-point blank holder was 3.27mm more in height than the normal blank holder. [12]

Nitin Kotkunde, Aditya D. Deole, Amit Kumar Gupta, Swadesh Kumar Singh, in this paper have performed deep drawing experiments on Ti6Al-4V alloy steel. Tests were performed over a temp ranging from room temperature to 400°C. Their they studied that formability bellow 150°C was very poor and increasing the temperature helped in increasing limiting drawing ratio to 1.8 for 400°C which is very less at lower temperatures. They used the heaters one for the blank and other for the die. They also used water for cooling purpose to control the temperature. Finite element analysis was also done in order to have a good argument with the quivered result. The thickness of the cups were measured and they were plotted along the graph. They concluded that uniformity of thickness distribution depends on blank diameter and temperature. At higher temperature more uniform thickness distribution was obtained. However thickness distribution obtained by FE simulations showed good agreement with experimental results. [13]

Mevlüt Türköz, Doğan Acar, Ekrem Öztürk, H. Selçuk Halka, in their experimentation used warm hydeomechanical deep drawing process in which the dies were heated and punches were cool. In this study effects of thermal coefficients on the temperature condition of the blank in the FE analysis of WHDD to conduct accurate FE simulations of the process was investigated. So it can be possible to predict deformation behaviour of the materials accurately and determining the proper forming conditions in less time and shorting development time. They found that while the heat transfer coefficient and thermal conductivity of the blank and tool materials affected to temperature distribution of the blank considerably, thermal conductivity of fluid between sliding surfaces and heat capacity of the tool material was not effective. [14]

Mevlüt Türköz, Muammer Koç, H. Selçuk Halkac, in this paper have performed warm deep drawing at temperatures 220°C and 300°C. In order to able to perform reliable FE analyses, accuracy of the analyses of the WHDD process were determined by comparing the limiting drawing ratios obtained by FE analyses and experiments. The FE analyses was conducted on FEA package Ls-Dyna solver. A quarter-model of the axisymmetric geometry of cylindrical cups were used. The LDR values were determined as 3 and 3.125 as respectively for two temperatures. While in FE analyses LDR values were determined as 2.95 at the temperature of 220 and it was determined as 3.125 at the temperature of 300. This showed the FE analysis had good argument with the actual process. Also FE analysis can predict cracks in WDD product. [15]

Mr.Bhushan Sanjay Paysheti, Dr. Shekhar Yadgiri Gajjal, in this paper used analytical methods to calculate various design parameters and forces required for the sheet metal operation. In order to verify that they used computer aided design and finite element analysis. In order to design they require press data, blank size, work strokes, die faces ,loading height of component , shut

©IJRASET: All Rights are Reserved

height of die, methods of loading and unloading the component ,various forces required for the operations etc. Various forces for cylindrical cup formation, elements of draw die, design layout of draw die, working mechanism of die, design of elements of draw die are also studied. They found that instead of traditional design techniques analytical, CAD and FEA tool are cost efficient and they can design quickly than traditional once. [16]

Yanyao Jiang, Jianjun Chang, Chu-Hwa Lee, in this paper performed an experimental approach to determine the torque tension relationship for a typical used bolted joint. In addition to the bulk torque tension relationship they also experimentally measure the threaded friction and the bearing friction between the knots and surface and the climb surface. The effect of washers made of different materials was also studied. They found it was appropriate to use the following equation to determine torque force relationship $T = KDF$, where T is torque K is torque coefficient, D is nominal diameter of bolt and Fish the axial force. Thus they found that the experimental procedure can investigate friction. Also the device can provide easy means of determining torque clamping force relationship. [17]

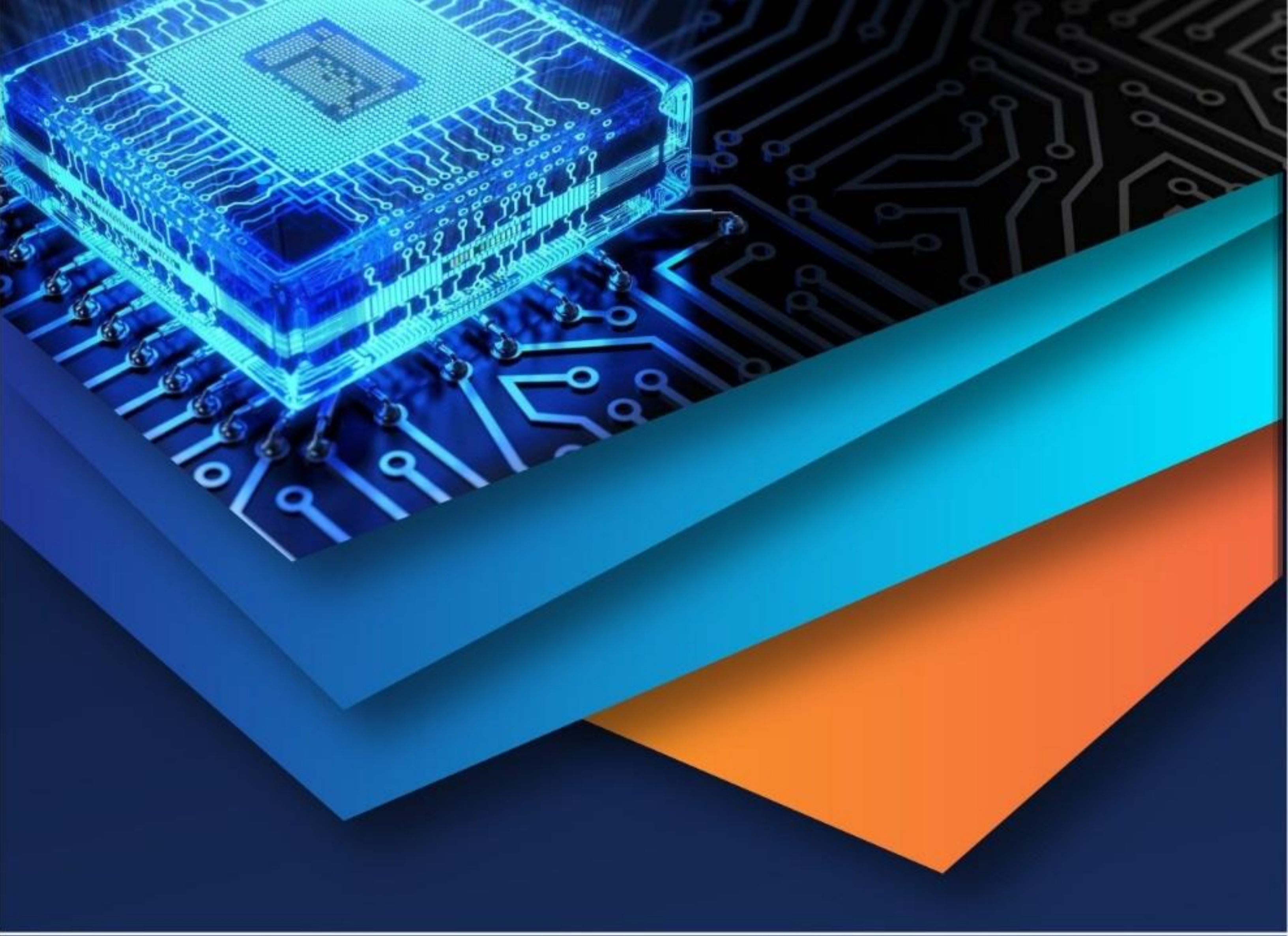
IV. CONCLUSION

From the literature survey as mentioned above it is known that various research has been performed on the parametric variation of the deep drawing process and still it is being studied. In warm deep drawing the effect of the die and punch temperature individually and combined has been studied. Drawing in general elevated temperature has been also studied for thickness distribution. Also factors affecting on the limiting drawing ratio has been surveyed. However the combined effect of the blank temperature and blank holding pressure on the punch pressure is yet to be looked after. Also their effect on the limiting drawing ratio is not studied yet. This gap in the research has been found out.

REFERENCES

[1] Rashmi Dwivedia and Geeta Agnihotrib, “Study of deep drawing process parameters”, 5th International Conference of Materials Processing and Characterization, 2214-7853, 2016
[2] Adnan I. O. Zaid, “Deep drawing mechanism, parameters, defects and recent results: state of art”, IOP Conference Series: Materials Science and Engineering, 2016
[3] M.A.M. Basril, H.M. Teng and I.A. Choudhury, “The effect of heating temperature and method towards formability of deep drawn square metal cup”, IOP Conference Series: Materials Science and Engineering, 2017
[4] N. Ethiraj and V.S. Senthilkumar, “Experimental investigation on warm deep drawing of stainless Steel AISI 305”, Applied Mechanics and Materials, vol 26-28, 2010
[5] N. Ethiraj, P. Ganesh and V.S. Senthil Kumar, “Theoretical Prediction of Thickness Distribution on Warm Deep Drawn AISI 304 Steel Cup”, Applied Mechanics and Materials, vol 766-767, 2015
[6] Nuri Sen, Ibrahim Karaagac, and Naci Kurgan, “Experimental research on warm deep drawing of HC420LA grade sheet material”, Springer, 2016
[7] Sumedh Kulkarni, Syed Nadeem Akhtar and Janakarajan Ramkumar, “Experimental Investigation of Formability Enhancement Using Hydraulic Counter Pressure Assisted Warm Deep Drawing”, Advanced Materials Research, vol 299-300,2011
[8] N. Ethiraj and V.S. Senthil Kumar, “Investigation on Formability of AISI 304 Circular Cups by Warm Deep Drawing”, Advanced Materials Research. Vols. 418-420, pp 1410-1417, 2012
[9] M. Ghosh, A. Miroux, R. J. Werkhoven, P. J. Bolt and L. A. I. Kesten, “Warm Deep Drawing and Post Drawing Analysis of Al-Mg-Si Alloys”, Journal of Material Processing technology, pp756-766, 2014
[10] Erdem Kayhan and Bilgin Kaftanoglu, “Experimental Investigation of Non-Isothermal Deep Drawing of DP600 Steel”, The International Journal of Advanced Manufacturing Technology, pp:695–706, 2018
[11] Vedant Savasa and Omer Secgin, “A new type of deep drawing die design and experimental results”, ELSEVIER, 2007
[12] M. Gavas, “Increasing the Deep Draw Ability of Al-1050 Aluminium Sheet Using Multipoint Blank Holder” METABK, Vol 45 (l2), pp 109-113, 2006
[13] Nitin Kotkunde, Aditya D Deole1, Amit Kumar Gupta1and Swadesh Kumar Singh, “Analysis of Thickness Strain Prediction in Warm Deep Drawing of Ti-6Al-4V Alloy”, Advanced Materials Research, Vol. 980 pp 52-56, 2014
[14] Mevlüt Türköz, Doğan Acar, Ekrem Öztürk and H. Selçuk Halka. “The Effect of Thermal Coefficients on Temperature Condition of the Blank in FE Analysis of Warm Hydro mechanical Deep Drawing Process”, International Journal of Advanced Research in Engineering, Vol 1(3), 2015
[15] Mevlüt Türköz, Muammer Koc and H. Selçuk Halkac, “Determination of the Accuracy of the Warm Hydromechanical Deep Drawing Process FE Analysis”, Research Gate, 2019
[16] Mr. Bhushan Sanjay Paysheti and Dr Shekhar Yadgiri Gajjal, “Design of Draw Die for Cylindrical Cup Formation”, International Engineering Research Journal, pp453-458, 2010
[17] Yanyao Jiang, Jianjun Chang and Chu-Hwa Lee, “A Experimental Study of the Torque Tension Relationship for Boated Joints”, Research Gate, 2001

©IJRASET: All Rights Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR:
7.129

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)